GRADED WIRING SYSTEMS

REFERENCE MANUAL FOR ARCHITECTS AND ENGINEERS

A MANUAL
ON THE USE OF

GRADED WIRING SYSTEMS

WITH "TIME-SAVER" SPECIFICATION TABLES TO FACILITATE THE WORK OF ARCHITECTS

GENERAL ELECTRIC COMPANY

MERCHANDISE DEPARTMENT

Bridgeport, Conn.

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FOR THE MOST EFFECTIVE USE OF THIS MANUAL

FIRST: Choose the relative grade of system from Part I and follow the standards established therein designing the layout.

SECOND: Find the desired materials for any *special* requirement in Part II, and refer to this section for special design data, dimensions, capacities, etc.

THIRD: Incorporate in the specifications the proper "standard of quality" specification paragraph and check list from Part III.

THEREAFTER: The use of Part III alone will solve the great majority of your design and specification problems.

GRADED WIRING SYSTEMS

IN the design of wiring systems for buildings the first consideration is the relative quality of the installation, in terms of cost, adequacy, completeness and durability of its component parts. One situation may demand an installation of minimum first cost; another may require low operating cost and a degree of adequacy and completeness that will attract tenants or buyers, or satisfy meticulous owners. Or the problem may be to design the finest system that present progress can envision.

HOW TO USE THIS MANUAL

PART I of this manual therefore establishes and defines three *grades* of wiring systems, G-E Code Grade, G-E Supr-Kode Grade and G-E DeLuX Grade. The first offers lowest first cost, the second low operating cost and a degree of adequacy consistent with satisfactory service, and the third meets the highest standards of adequacy and performance commercially practical at present. By adopting one of these three grades and adhering to the corresponding standards established in Part I of this manual, the design of the system in compliance with the owner's requirements is greatly simplified.

The second consideration is the selection of materials appropriate to the chosen grade of system, and suited to the intended service. A few wiring materials, such as rubber-covered wire, are made in several grades of quality; the majority are made only in one grade but in different types. These variations in type reflect differences in cost, durability, convenience or adequacy that affect the quality of the designed system according to the manner in which they are used. The problem of selecting the right grade or type of wiring material for each part of an installation has heretofore been troublesome to anyone but an expert.

PART II therefore presents General Electric Wiring Materials in terms of their *logical uses* rather than in the ordinary catalogue manner. Only the major elements that are normally specified by owner, architect, or builder are listed; those fittings and accessories which the electrical contractor selects to solve installation problems are omitted. Each type and kind of material is described in a way to simplify correct selection in keeping with the relative quality of the system.

The third problem is to reduce the effort necessary to make sure that the installed system meets the owner's requirements. This means, as far as possible, the *automatic* selection and specification of materials required to complete the installation indicated upon the architect's drawings.

PART III offers a reliable short-cut method of specifying the correct type or grade of wiring materials for any normal building installation, *according to the relative quality of the design* of that system. Representative materials for each part of the system are set up as standards of type or quality in a specification that permits the contractor to select the exact unit required for each purpose, but prohibits the substitution of inferior materials.

PART ONE

THREE GRADES OF QUALITY IN WIRING SYSTEMS

IN the design of every building there are always certain basic factors which influence the ultimate quality of the structure. In the case of commercial buildings erected for rental income the predominant factor may be maximum return on a minimum investment. In the case of dwellings erected for immediate sale the owner may seek minimum cost regardless of quality. Or in the case of a private house, a church, hospital, or other institutional building, cost may be subordinated to satisfactory performance over a long period of years, or to a desire to have the very best structure and equipment.

The wiring systems which are to be made a part of any building should correspond in relative quality to the structure itself. It is equally unsatisfactory to put a cheap and incomplete wiring system in a building erected for many years of efficient service, or to install in a cheaply built structure a wiring system of superior grade.

For this reason General Electric has established three grades of wiring systems. They are defined and described as follows:

G-E CODE Grade Wiring System

FOR LOW COST AND TEMPORARY BUILDINGS, COMPLYING WITH N. E. CODE

THIS G-E Code Grade designates a wiring system designed merely to comply with the requirements of the National Electrical Code or of local governing codes of greater stringency, and to provide only the number of circuits and outlets required to meet the immediate demands of the structure it serves. It is a minimum standard and calls for the use of the least expensive wiring materials permitted by governing regulations and the nature of occupancy of the structure.

ADVANTAGES AND DISADVANTAGES

The chief advantage of G-E Code Grade Systems is low first cost. The National Electrical Code and the local governing ordinances are designed primarily to assure safety and any Code Grade System is acceptable to fire insurance companies. The disadvantages in the use of systems designed to these minimum standards are: (1)—Operating costs are relatively high because these governing codes do not take into consideration the loss of voltage in circuits due to excessive length or inadequate wire size; (2)—expansion or extension to meet increased future demand is expensive because these governing codes require no provision for increased loads; and (3)—maintenance and repair expense may be higher than normal through the use of the cheapest types of grades of material permitted by the codes.

APPLICATION

Systems designed in accordance with G-E Code Grade standards should be used only where minimum initial cost is sought without regard to increased future demand, to operating costs, or to the eventual cost of replacements or extensions. It is recommended only for temporary structures. It may be used, however, in speculative buildings where a minimum selling price is the chief concern.

G-E SUPR-KODE Grade Wiring System

FOR UP-TO-DATE BUILDINGS DEMANDING MODERN CONVENIENCE AND ADEQUACY

THE G-E Supr-Kode Grade designates wiring systems designed to meet or exceed the "Minimum Specification for Adequate Wiring of Lighting Circuits in Commercial, Public and Industrial Structures," and the "Adequacy Wiring Standards for Residence Buildings" as promulgated by the properly designated committees of the industry.

APPLICATION

Systems designed in accordance with G-E Supr-Kode Grade standards should be employed wherever operating economy, convenience in use, ease of expansion, and satisfactory performance over a long period of years are primary considerations. Such systems are recommended for all modern buildings with the exception only of structures of superior quality, such as de luxe residences and important institutional or memorial buildings of enduring character where still higher standards are required in keeping with the quality of the building. The G-E Supr-Kode standards should be looked upon as minimum under present day demands for electric service. They are in no manner extravagant in cost but rather seek to save expense in the long run through eliminating voltage losses and minimizing future expansion, and repair and maintenance expense.

G-E Supr-Kode Grade standards should be adopted in all commercial buildings erected for rental income and in all structures offered by responsible buildings for immediate sale, because the higher standards of service provided by such systems increase rentability or salability in excess of their greater cost over Code Grade Systems. They should also be used in all factory and industrial plants and in all privately owned structures because of their operating economy and low maintenance and replacement cost. They should also be considered the minimum specification for all institutional and memorial buildings of enduring character, including all public structures, because they make provision for the steady increase in the use of electricity and thus tend to defer obsolescence.

ADVANTAGES

The principal advantages resulting from the adoption of G-E Supr-Kode standards have already been indicated. There are no disadvantages, unless circumstances make initial installation cost of considerably greater importance than ultimate cost throughout a reasonable period of operation. The difference in cost between an installation meeting G-E Code Grade standards and one following G-E Supr-Kode standards is negligible when expressed as a percentage of the total cost of the building either system serves. The difference is usually offset within the first year or two of operation, or by the greater rentability or salability which superior electrical service assuredly offers.

DESIGN STANDARDS FOR G-E SUPR-KODE GRADE WIRING SYSTEM

THE following basic standards apply to the design of all G-E Supr-Kode Grade Systems. All standards are based upon 115 volt or 115-230 volt distribution systems.

1. **Wire Sizes.** No wire smaller than No. 12 shall be used for 15 ampere branch circuits. For runs of over 50 feet from panelboard to first outlet no wire smaller than No. 10 shall be used for that portion of the circuit, and none smaller than No. 12 between outlets. Runs exceeding 100 feet from panelboard to first outlet shall be avoided wherever practicable; if they cannot be avoided the initial load shall not exceed 600 watts, except in the case of a single lamp of greater wattage, when No. 8 wire shall be used, and areas served by lighting outlets, as specified in the governing "Minimum Specifications for Adequacy in Lighting Circuits," shall be reduced by 40%.

2. **Voltage Drop** shall not exceed 1½% (preferably 1½ volts) in any feeder or branch circuit where loads and circuit lengths are known and wire sizes can be computed.

3. **Initial Load** on 15 ampere lighting circuits shall not exceed 1,000 watts (except in the case of a single lamp of larger size), and the number of circuits and their outlets shall be arranged accordingly.

4. **Convenience Outlets** shall not be placed on the same circuit with outlets for general illumination. Where devices rated at 500 to 1,650 watts input are likely to be connected to convenience outlets, No. 10 and No. 8 wire shall be used instead of No. 12 and No. 10 respectively, as specified in paragraph one above. All convenience outlets shall be duplex outlets unless designed to serve a single appliance or device of known character.

5. **Power Loads** or loads requiring a high starting current shall not be fed by a lighting feeder. Known power loads (for fixed or semi-fixed apparatus or appliances) shall be served by special circuits designed to carry the maximum load likely to be imposed at any time with a maximum voltage drop of 1½%. Variable loads of this type served by convenience outlets (such as household or office appliances having heavy starting loads) shall be served by special circuits and convenience outlets similarly designed and suitably distinguished by polarity outlets or otherwise from ordinary convenience outlets.

6. Conductors and Raceways. All feeders and subfeeders which may be required in the future to carry increased loads due to the extension of the system or to the use of higher lighting intensities or heavier power loads shall be run in rigid conduit. These conduits shall be of such size as to permit the future accommodation of conductors having double the current-carrying capacity of the initial installation. All branch circuits which, by the nature of the occupancy of the building, may be subjected to future enlargement or change, should be installed in rigid conduit or underfloor ducts in order to minimize alteration and replacement expense. Branch circuits and minor extensions, including all branch switch services, may be run in armored cable where permitted by the National Electrical Code or local governing ordinances. All conductors used throughout the system shall be of flame-retarding intermediate grade rubber-covered wire, except where special types of wires or cables are required by governing codes.

7. Wiring Materials. All other wiring materials, including switches, outlets, lampholders, switch and outlet boxes, switch and outlet plates, and special fittings and accessories, shall be of that type and quality best adapted to render adequate and enduring service under the conditions imposed on each part of the system.

In addition to these basic standards the design of specific installations shall be in accordance with the following minimum specifications, copies of which may be secured through any General Electric office upon request.

RESIDENCE BUILDINGS

THESE include private houses and all types of multi-family dwellings: Follow the "Adequacy Wiring Standards for Residence Buildings" as prepared by

Artistic Lighting Equipment Assn.
Association of Electragists, International
Illuminating Engineering Society
National Electric Light Association (now Edison Electric Institute)
National Electrical Mfrs. Association
National Electrical Wholesalers Assn.
Society for Electrical Development, Inc.

and endorsed by International Association of Electrical Inspectors. Dated September 1, 1932.

COMMERCIAL, INSTITUTIONAL AND PUBLIC STRUCTURES

THESE represent all buildings except dwellings, apartments, hotels, industrial plants and buildings with interiors requiring special considerations, such as theatres, auditoriums, banking rooms, etc. Follow the "Minimum Specification for Adequate Wiring of Lighting Circuits in Commercial and Public Structures" as prepared by the Commercial and Industrial Lighting Committee, Edison Electric Institute.

NOTE: Special requirements are included in the foregoing for store and office buildings.

INDUSTRIAL STRUCTURES

THESE include factories, mills, workrooms, repair shops, enclosed piers and docks, garages, warehouses and any other buildings used for manufacturing, repairing, or material handling. Follow the "Minimum Specification for Adequate Wiring of Lighting Circuits in Industrial Structures" as prepared by the Commercial and Industrial Lighting Committee, and Wiring Sales Committee, National Electric Light Association.

G-E DELUX Grade Wiring System

FOR ENDURING STRUCTURES REQUIRING THE FINEST WIRING SYSTEM AVAILABLE

THE G-E DeLuX Grade designates wiring systems designed to provide the maximum of convenience and performance for present and estimated future requirements, and the maximum durability of all elements under the most advanced standards of present-day commercial practice.

APPLICATION

SYSTEMS designed in accordance with G-E DeLuX Grade standards are intended to represent the highest quality of installation that can be developed with commercially available materials. They are appropriate to all buildings of enduring character, such as major public structures, monuments, memorials, and to important institutional buildings such as hospitals, banking structures, cathedrals, etc. They are also appropriate to residences of the highest

type, including the finer cooperative and investment apartment structures.

ADVANTAGES

THESE G-E DeLuX Grade Systems possess all of the advantages of G-E Supr-Kode Systems, with the additional merit of providing more liberally for anticipated future loads and for minimum obsolescence over a long period of years. Replacement or repair expense should be at an absolute minimum and operating cost should be the lowest consistent with a reasonable initial investment.

Such systems are intended primarily for structures where lasting satisfaction is paramount to initial investment.

DESIGN STANDARDS FOR G-E DeLuX GRADE WIRING SYSTEM

THE following standards govern the basic design of G-E DeLuX Grade Systems. In addition, DeLuX Grade Systems should be designed in accordance with the standards established for Supr-Kode Grade Systems where these standards are not less than the requirements set forth in the following paragraphs. All standards are based upon 115 volt or 115-230 volt distribution systems.

1. **Wire Sizes.** No wire smaller than No. 12 shall be used for 15 ampere circuits. For runs of over 35 feet from panelboard to first outlet no wire smaller than No. 10 shall be used for that portion of the circuit and none smaller than No. 12 between outlets. Runs exceeding 75 feet from panelboard to first outlet shall be avoided wherever practicable; if they cannot be avoided the initial load shall not exceed 500 watts, except in the case of a single lamp or appliance load of greater wattage, when No. 8 wire shall be used. An area served by lighting outlets as specified in the governing "Minimum Specifications for Adequacy in Lighting Circuits" shall be reduced 40%.

2. **Voltage Drop** shall not exceed 1% (preferably one volt) in any feeder or branch circuit where loads and circuit lengths are known and wire size can be computed.

3. **Initial Load** on 15 ampere lighting circuits shall not exceed 1,000 watts, and the number of circuits and their outlets shall be arranged accordingly.

4. **Convenience Outlets** shall not be placed on the same circuit with outlets for general illumination. All convenience outlets intended primarily for supplementary lighting loads shall be duplex outlets. All convenience outlets intended to serve appliances or power devices of known character shall be of the polarity type.

5. **Power Loads,** or loads requiring a high starting current, shall not be fed by a lighting feeder. Known power loads (for fixed or semi-fixed apparatus or appliances) shall be served by special circuits designed to carry the maximum load likely to be imposed at any time with a maximum voltage drop of 1%. Variable loads of this type served by convenience outlets (such as household or office appliances having heavy starting loads) shall be served by special circuits and convenience outlets similarly designed and suitably distinguished by polarity outlets or otherwise from ordinary convenience outlets.

6. **Conductors and Raceways.** All conductors shall be carried in rigid conduit regardless of the type of building, except that branch circuits may be run through underfloor ducts where circumstances warrant. All conduits and raceways shall be of sufficient size to permit the ultimate doubling of the capacity of the initial circuits. All the conductors shall be of flame-retarding 30% performance rubber-covered wire, except where special types of wire or finishes are required by excessive dampness, heat or other conditions of service.

7. **Wiring Materials.** All other wiring materials, including switches, outlets, lampholders, switch and outlet boxes, switch and outlet plates, and special fittings and accessories shall be of the highest grade or of the best type commercially available to render adequate and enduring service under the conditions imposed on each part of the system. Heavy-duty units should be employed in preference to standard units in all outlets subject to constant service.

SPECIAL REQUIREMENTS APPLYING TO DWELLINGS

8. **Twin Convenience Outlets** shall be provided at intervals not exceeding 5 feet in the walls or baseboard of every room not devoted to specific service purposes, such as kitchens, laundries, bathrooms and passageways; and at least one twin outlet shall be provided in every such wall section between doors or room corners, more than 18 inches wide, where any piece of furniture or any decorative or service lighting unit might at some time be placed.

9. **"Step-Saver" Switches** (three-way and four-way as required) shall be provided to control at least one major light source in every room having two or more doors, these switch controls to be placed at each door. In addition, three-way and four-way switches shall be used to control lights in all halls or passages, between house and garage, and at any other place where a person passing from one point to another may control the lighting from any point of entrance or exit.

10. **Mercury Tube Switches** shall be used to control light sources in every bedroom, nursery, bathroom, or hallway between such rooms, and elsewhere that the sound of operating a snap-switch may prove objectionable to any occupants of the dwellings.

11. **Separate Circuits** or special power circuits shall be provided to serve convenience outlets in kitchens, pantry, dining rooms, living rooms, principal bedrooms, bathroom or other areas where any portable appliance drawing 1,000 watts or more (such as a large automatic toaster, waffle iron or radiant heater) may be used.

PART TWO

WIRING MATERIALS

THE principal types of wiring materials which are considered by the architect, electrical engineer or owner in establishing the relative quality of a complete wiring system are described in the following pages. Special attention is paid to the character of service each unit is designed to perform. It should be understood that only a few types of materials, such as rubber-covered wires, certain kinds of switches and outlets, switch and outlet plates and lampholders, are made in different grades of quality to serve substantially the same electrical purpose. Most wiring materials are made only in one quality for a given function or purpose; but in such cases the differences between types are designed to meet varying conditions of service and therefore their correct use influences the quality of the completed system. These distinctions between grades and types are made clear in the following descriptions.

Minor accessories, fittings and construction materials which must be selected by the electrician or electrical contractor, according to the conditions under which each installation is made, are *not* described in these pages. The purpose is to eliminate the confusion that would otherwise attend a complete description of the several thousand items in the complete General Electric line of wiring materials. For a complete list, see the G-E Merchandise Catalogue, a copy of which will be supplied to any responsible individual upon application.

All materials are grouped according to the parts of the system in which they are normally employed. Where basic materials, such as conductors, raceways, outlet boxes, etc., are used in all divisions of the system, cross references are indicated.

Service Entrances and Distribution Centers

EACH utility company supplying electrical service establishes rigid requirements governing the materials that must be employed from the utility company's service pole through the meter and service switch to the distribution panel. Owners and architects have little opportunity or need to select and specify these materials on their own account. They should consult the utility company and follow the requirements thus established. Occasionally, however, the utility company will permit the use of underground entrances at the owner's expense where overhead entrances are otherwise standard, and occasionally also the same materials used for service entrances may be required for connections between isolated buildings on the owner's property (as in the case of separate buildings on a private estate).

For this reason the materials offered by General Electric which are commonly used for service entrances and distribution centers are illustrated and briefly described herewith.

Service Drop Cable. For use overhead from the street to the point of attachment on the building, and for overhead use between buildings on estates or in parks. Consists of two rubber-covered wires and one braid-covered wire (neutral) or two rubber-covered wires only, enclosed in weatherproof tape and braid. Sizes No. 10 A.W.G. to and including No. 2 A.W.G. stranded.

Service Entrance Cable—BX type. For use from point of attachment of service wires on the building to the service entrance switch. Does not require use of rigid conduit, subject to local practice. A heavily covered armored multiple conductor cable of BX type made weatherproof. Durable in all climates.

Service Entrance Cable—AEIC concentric type. For use from the point of attachment of service wires on the building to the service entrance switch. Does not require use of rigid conduit, subject to local practice. This is a

newly approved type of cable consisting of one or more standard rubber-covered conductors and a concentrically applied standard bare conductor protected by galvanized strip armor and a heavy weatherproof covering.

Rigid Conduit Entrances. Rigid conduit is recommended (and required by many cities and utility companies) for use from point of attachment of service wires to the service entrance switch. It is also used for underground entrances from street pole to service entrance switch. For descriptions and grades of rigid conduit and wires employed therein, see "Distribution Materials".

G-E 600-volt Leaded Cable. For underground service entrances in rigid conduit. Has solid or stranded conductors with standard NE Code thickness and grade of rubber, and enclosed in lead sheath for positive moisture protection. It is flexible and can be readily pulled through conduit. Lead-sheathed cable should always be used in underground rigid conduit installations, and, conversely, leaded cable should always be protected from mechanical injury by the use of rigid conduit or fibre conduit (G.E. Fiberduct) encased in concrete.

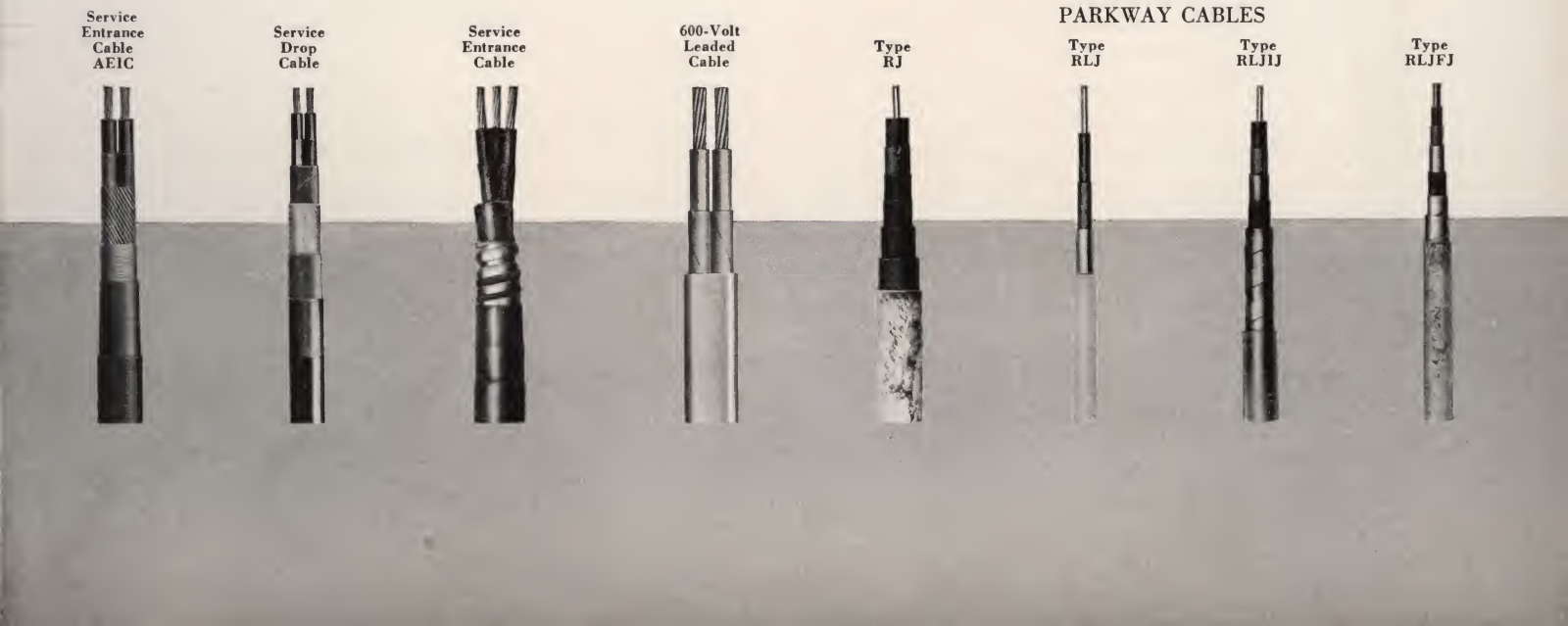
Parkway Cables. A group of four types, all used for underground service entrances and other underground distribution (as for gardens, park lighting, between buildings on private estates) where cable is buried without use of conduits. All have rubber-covered conductors. All types may be laid in shallow trenches, merely deep enough to minimize disturbance, except where traffic is heavy (as under streets), where a depth of 30 inches is recommended.

Type RJ Non-Metallic Parkway Cable. An economical lightweight cable protected against moisture and mechanical injuries by multiple layers of vacuum impregnated fabric tape and jute wraps. Serviceability attested by years of use.

Type RLJ Leaded Jute Wrapped Parkway Cable. An economical small-sized cable for use in moist locations where mechanical protection to conductors is not essential. Has a lead sheath for protection against moisture and an asphalt saturated jute wrap over the lead.

Type RLJIJ Lead Sheathed Interlocking Armor Parkway Cable. A superior underground cable having maximum resistance to crushing stress without loss of flexibility. The rubber-covered wires are sheathed with lead, then with an impregnated jute cushion, over which is an interlocking BX steel armor which, in turn, is enclosed in an impregnated jute wrapping. Recommended for locations in rocky formations.

Type RLJFJ Lead Sheathed—Flat Strip Armor Parkway Cable. The most popular underground cable for use without conduit. It is extremely resistant to mechanical injury and durable in any soil. Consists of a lead sheath over the conductors with a double wrap of steel tape and impregnated jute exterior covering, providing ample mechanical protection and maximum protection against moisture.



DISTRIBUTION MATERIALS

THIS division of an electrical system embraces the conductors, their protective enclosures or raceways, and the outlet boxes and similar accessories required for the distribution of electrical current from the service entrance or distribution center to the outlets where loads are applied, or where switches are used to control the application of power.

IDENTIFICATION OF CIRCUITS

ALL G-E building wires can be supplied in eight distinctive color braids to simplify circuit identification and circuit testing. Their use saves time whenever a large number of circuits is involved and facilitates future extension and alteration work. *Distinctive color braids* should be employed to identify feeders, lighting circuits, power circuits, burglar alarm systems, hospital paging systems, watchman's call systems, radio circuits, and all other special installations. These colors may be selected at will so that individual lines can readily be traced and complete records established on special or complicated installations.

The colors are eight in number, as follows:

Black	Yellow
Blue	Brown
Red	White
Green	Orange

DESCRIPTION OF WIRES AND CABLES

Grades of Rubber-covered Wires and Cables. In addition to colored braids for identification purposes, G-E wires and cables may be distinguished as to the grade of insulation employed by distinctive colors in the rubber insulation.

BraidX Non-metallic Sheathed Cable

Code Grade Wire—black rubber insulation.

Intermediate Grade Wire—red rubber insulation.

30% Performance Grade Wire—green rubber insulation.

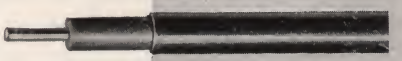
These differences in quality are based upon established standards. Their use and value may be indicated as follows:

Code Grade Wire. The insulation here employed meets with the standard requirements of the National Electrical Code and the specifications of Underwriters' Labora-

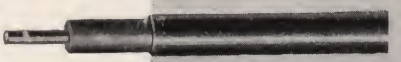
Rubber-covered Wires

Code Grade Black Rubber Insulation

Intermediate Grade Red Rubber Insulation



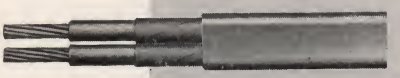
30% Performance Grade Green Rubber Insulation



Rubber-Insulated, Lead-covered Cables

Single-Conductor

Two-Conductor



Lamp Cords and Portables

Parallel Lamp Cord Type PO

Twisted Lamp Cord Type C

Reinforced Portable Cord Type P

Special Portable Cord Type PD

BXL
Lead Sheathed
Armored Cable

tories, Inc. The serviceability of this grade of wire has been attested by many years of use, but the relative durability of the insulation is not equal to either of the following grades. G-E Code Wire is, therefore, primarily adapted to G-E Code Grade Wiring Systems.

Intermediate Grade Wire, with red rubber insulation, has physical and electrical characteristics superior to Code Grade insulation and proportional longer life.

30% Performance Grade Wire, with green rubber insulation, must pass oxygen bomb tests which are considered equal to approximately ten years of natural aging.

These two grades are, therefore, correspondingly more durable than Code Grade Wire. For general wiring purposes these two grades of wire should be employed in all buildings where standards of adequacy govern in place of minimum standards established by the National Electrical Code. Intermediate Grade Wire should be used in all G-E Supr-Kode Grade Systems as the minimum standard. 30% Performance Grade Wire should be used throughout G-E DeLuX Grade Systems.

"Safecote" flame-retarding finish on G-E Building Wires. G-E building wires are made with a flame-retarding finish in Code, Intermediate and 30% Performance Grades to meet recent changes in the local requirements of many communities, as well as anticipated changes in the Code of Fire Underwriters. This finish not only provides the required protection against moisture, but also reduces the fire hazard. It will not support combustion, and thus prevents flames from traveling along the braid. Other finishes are described in connection with the standard wires listed below.

BX
Armored
Cable

Wires and cables for special purposes. The General Electric Company manufactures all types of wires and cables required to meet special conditions of service in accordance with the standards of the National Electrical Code and the specifications of Underwriters' Laboratories, Inc. Since the selection of special wiring materials involves a knowledge of the conditions of service, only the major types are described below. (See General Merchandise Catalogue for detailed description of individual types.)

Lead-covered Rubber-insulated Wires and Cables. Lead-sheathed wires and cables insulated with National Electrical Code rubber compound

Delabeston Wire and Cable

Stove Wire

Heater Cord

Switchboard Wire

Fixture Wire

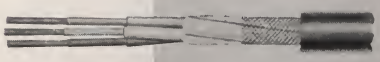
Motion Picture Cable

Cotton-covered Fixture Wire

Lamp Cords and Portables

Portable Cord Type K

G-E Flex Portable Cord, Type S



Single Conductor Fixture Cord

Telephone Wire

(or on special order, insulated with Intermediate or 30% Performance Grade rubber) are provided in all standard sizes and with single or multiple conductors for use in clean, dry conduits, boxes, or in any location where the cable is not exposed to mechanical injury or liable to corrosion. These are rated for 300 and 600 volts.

Deltabeston Wire and Cable. Where wiring is subject to high temperatures, rubber insulations are rapidly destroyed. Hence a complete line of all-asbestos insulated and part-asbestos insulated wires and cables are offered under the general term "Deltabeston Wire and Cable." These wires are made for switchboard wiring, electric stove and range wiring, range cable, motion picture machine cable, arc lamp cable, and for the wiring of lighting fixtures where high temperatures (in excess of 120 degrees F.) are likely to be encountered. (For detailed descriptions, see General Merchandise Catalogue.) Deltabeston fixture wires are also made with color finishes for separation of circuits and are then called Colorbeston Fixture Wires.

Fixture Wires. The National Electrical Code establishes precise standards for wires used in lighting fixtures, classifying the wires permitted into seven groups, four of which, including two classes of flexible cords, are classified under "Heat resisting" Fixture Wire and Flexible Cords. The remaining three groups are classified under Rubber-Covered Fixture Wire. General Electric Company provides fixture wires of all seven types. (Detailed descriptions are given in the General Merchandise Catalogue.)

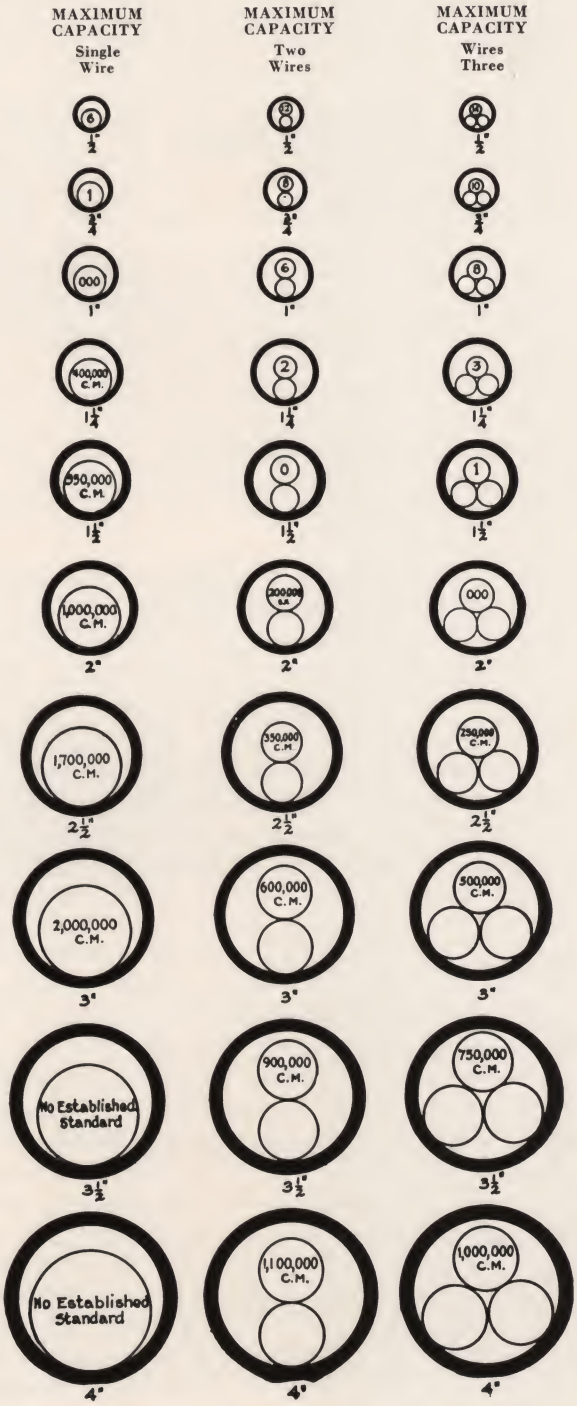
Cables. Similarly, General Electric Company manufactures all types of cords, the use of which is permitted under the National Electrical Code and in various grades of insulation to meet special conditions of service.

USE OF ARMORED AND SHEATHED CABLES

UNLESS wires are run in rigid conduit, underfloor ducts, or other protective raceways, they must be safeguarded against mechanical injury by a flexible enclosure in addition to the insulation required for electrical protection only. The armored and sheathed cables made for this purpose are primarily used for wiring in stud type buildings where the installation of rigid conduit would be difficult or excessively expensive, and for making minor extensions to branch circuits in other types of buildings where, for similar reasons, the use of a conduit or raceway is not practical.

SIZES of CONDUIT

WITH NUMBER OF WIRES PERMITTED UNDER CODE



DESCRIPTION OF PROTECTIVE CABLES

BX Armored Cable consists of one or more rubber-covered wires with single braids enclosed in transversely crumpled strips of moisture-proofed Kraft paper with an allover covering of flexible interlocking-type steel armor. Ordinarily, BX is made up in "Safecote" Flame-retarding Code Grade Wire, but can be obtained with Intermediate or 30% Performance insulated conductors on order.

Oval BX Cable is similar to round BX cable, except that the multiple conductors are laid flat and the armor is moulded to an oval shape to permit installation within plaster with no necessity for grooving the masonry beneath.

BXL Lead-sheathed Armored Cable consists of rubber-insulated conductors twisted together with allover cotton braid saturated with scale wax. A lead sheath is applied over the braid and a BX type interlocking steel armor is applied over the lead.

BraidX Non-metallic Sheathed Cable. This material consists of two or three insulated conductors with a special protective covering over the rubber insulation which has relatively high resistance to mechanical injury. When required, BraidX may be supplied with a non-insulated copper conductor laid in next to the insulated conductors to be used for grounding purposes only.

USE OF RACEWAYS

RACEWAYS, such as rigid conduit, flexible conduit, metallic tubing, and underfloor ducts, have three distinct advantages. (1)—They provide the requisite mechanical protection for wires; (2)—they permit wires to be installed after the structure is finished and thus eliminate the possibility of circuits being injured during construction work; and (3)—they permit withdrawing existing circuits for repair or for replacement with new or additional circuits of greater capacity. The use of such raceways is required in all fireproof buildings; their advantages are no less important in residences and other non-fireproof structures.

DESCRIPTION OF RACEWAYS

Rigid Metal Conduit is the standard type of raceway for buildings of fireproof construction where the wiring must be buried in concrete, masonry, or similar materials, and for exposure wiring in locations where the maximum ability to withstand mechanical injury is required. It prevents those disturbances of conductors which give rise to open and short circuits. It prevents rats from gnawing the insulation on the enclosed wires; it minimizes the hazard of nails being driven through the raceway and striking the conductors; its tight joint keeps out water and chemicals which may disintegrate the insulation; and its all-metal construction provides effective grounding and thus safeguards both life and property from electrical hazards. It also acts as a shield, preventing the induction of electrical currents from one to another, a frequent source of interference with telephone and radio communication systems.

Rigid conduit is a thick-walled steel tubing of the same weight and strength as full standard weight steel pipe, and is equipped with threaded fittings joining the lengths to each other and to standard outlet, junction or pull boxes. Two types are offered by General Electric.

G-E Galvanized "Hot-Dipped" Conduit (Greenfielduct). In the manufacture of G-E White Conduit the finished steel pipe is first galvanized inside and out by the "Hop-dipped" process which fuses the zinc coating into the surface of the steel to form a perfect mechanical bond. The galvanized pipe is then coated inside and out with *Glyptal*, a flexible synthetic resin that is waterproof, and acid and

TYPES OF RACEWAYS

G-E Electrical Metallic Tubing
A thin wall rigid raceway made from open-hearth steel and ductile enough for easy installation. Electro - galvanized finish only.

G-E Oval Tubing
Available in electro - galvanized finish only. The line of fittings is so designed that interchangeability of wiring systems may be effected whenever desired.

G-E Single Strip Conduit
This is a galvanized flexible steel conduit. Fittings are adapted to each size.

G-E Black Rigid Conduit
Finished in special heavy black enamel. Conduits are furnished in 10-foot lengths, threaded on both ends, with coupling on one end.

G-E White Rigid Conduit
Galvanized under the 'Hot-Dipped' process and Glyptal coated. Complete tabulation of sizes will be found in the General Merchandising Catalogue.

alkaline resistant. *Glyptal* also offers a smooth, non-abrading surface on the interior of the conduit which facilitates the pulling of wires.

G-E Black Rigid Conduit. In the manufacture of G-E Black Conduit the finished steel pipe is dipped in a bath of black enamel of special formula. This enamel is one of the toughest, most elastic enamels known. It provides thorough protection against corrosion, unless the enamel is mechanically destroyed or abraded.

Sizes of Rigid Conduit. The accompanying tables and diagrams show the standard sizes of conduit for the installation of wiring cable as established by the National Electrical Code. Larger sizes are recommended for Supr-Kode and DeLuX Systems where provision is made for future circuits doubling the capacity of the original installation.

Galvanized Flexible Metal Conduit. Wherever a raceway system, through which wires are subsequently to be drawn, requires a flexible section to meet difficult installation conditions or to provide coupling to adjustable equipment, such as a motor mounted on a belt-tightening base, flexible metal conduit is employed. It is also recommended for temporary wiring installations where local requirements (as in New York City) demand the temporary wiring to be in metal conduit. Its use is approved for all conditions except on the exterior of buildings, in hoistways (with special exceptions), in hazardous locations, in storage battery rooms and for overhead service conductors entering buildings.

Galvanized flexible metal conduit consists of an interlocking flexible steel armor made in sizes 5/16″ to 3″ inclusive.

G-E Electrical Metallic Tubing is a thin-wall rigid raceway manufactured from open-hearth electro-galvanized steel and is sufficiently ductile for easy installation, including wide radius bends. Compression couplings and connectors are employed for joining lengths of the metallic tubing to each other or to outlet and junction boxes. The walls are substantially lighter in weight than the walls of rigid metal conduit and, therefore, do not offer the same degree of protection against mechanical injury and against corrosive action of water or chemicals on the steel. Otherwise electrical metallic tubing performs the same functions as rigid conduit at slightly lower material cost, subject to restrictions imposed by the National Electrical Code.

Oval Tubing. Similar in character to electrical metallic tubing, oval tubing provides a more compact raceway for minor exposed circuits and for under-plaster extensions. In general it is employed only under conditions where extensions of raceway type are required, for which standard types of tubing or conduit are not practical.

Underfloor Raceways G-E Fiberduct

THESE are non-corrodible raceways for underfloor wiring in concrete floors. They provide practical means for bringing conductors for lighting, power, telephone and signalling systems to any part of a floor area. So designed that neat-appearing outlets may be installed safely and economically at any point along the line of duct and at any time during the life of the building. The principal elements comprising the G-E Fiberduct Underfloor Wiring System are:

(a)—**G-E Fiberduct,** which is composed of impregnated fibre that successfully resists every known type of corrosion encountered in actual service. Conclusive evidence of its resistance to corrosion is furnished by the millions of feet of fibre underground conduit which have been installed by pubilc utilities in all sections of the country during the last quarter of a century. The fibrous compound is formed into a flat oval tubing with an internal area of 3 sq. in., an overall height of 1½ inches, and an overall width of 3¾ inches.

(b)—**Junction Boxes** of single, double and triple type to meet various requirements of layout, as illustrated in the diagrams on Page 16. Also elbows, cross-under fittings, and miscellaneous other accessories necessary to complete the duct system.

(c)—**Surface Fittings** to provide appropriate outlets for lighting, power, and communication system connections, together with floor plates, flanges, and other elements required to penetrate the concrete floor surface and connect with the underfloor raceway. Typical elements are illustrated.

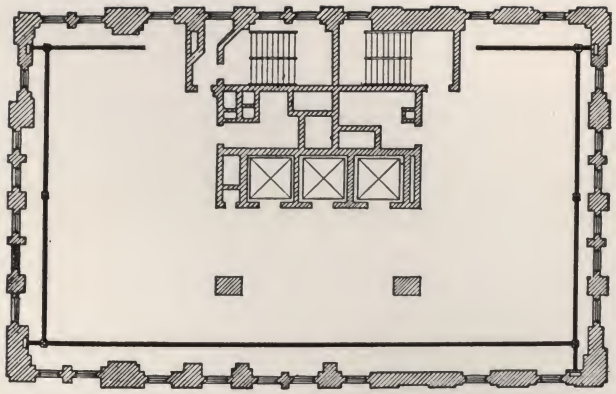
(d)—**Prelokaylets.** These are outlets that may be attached to the Fiberduct before it is embedded in the concrete at predetermined locations. They can be clamped on the duct on the job by means of special tools or can be set at the factory at any specified spacing. Magnetic or meter-type finders are provided for spotting Prelokaylets beneath the finished floor surface with accuracy. These devices locate a magnetized pin in the cap of each Prelokaylet.

Typical details of installation are shown in the accompanying illustrations on Page 17. A complete manual on G-E Fiberduct Underfloor Raceways may be obtained on request.

TYPICAL FIBERDUCT LAYOUT DIAGRAMS

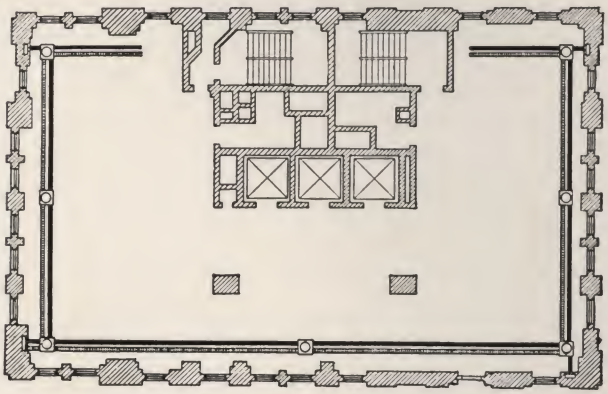
Single Runaround Layout

THE major portion of the demands for power and telephone service is around the outside walls where desks are most frequently located. For the sake of economy, the Single Runaround Layout has been employed in many buildings and has given satisfactory results even though it provides only the minimum of floor covering.



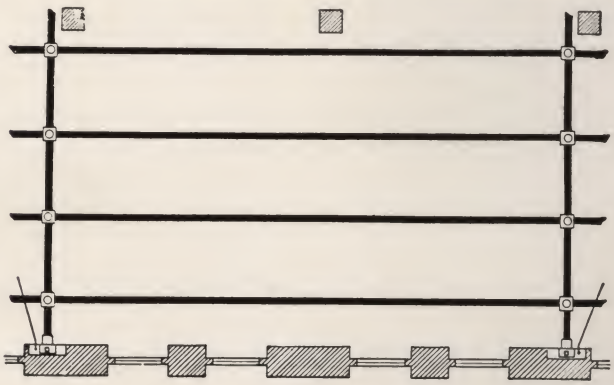
Double Runaround Layout

THE Double Runaround Layout possesses the same advantages and limitations as the Single Runaround Layout except that it has parallel ducts and double compartment boxes. This Layout provides a raceway for wiring to electrically operated office machines and a separate raceway for telephone or signal wiring.



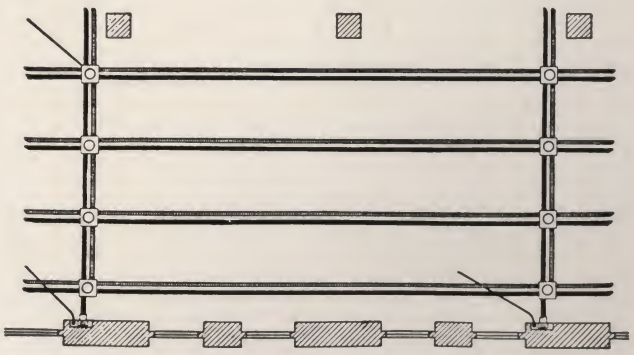
Single Grid Layout

THE Single Grid Layout gives complete floor coverage for either power and lighting or telephone and signal distribution. The first line of duct is generally laid approximately three feet from the outside wall, as in the case of the Runaround Layouts. Complete floor coverage is then obtained by placing other duct lines parallel to it at intervals of approximately five feet.



Double Grid Layout

THE Double Grid Layout is a 100% system. It gives complete floor coverage and provides for power and lighting as well as telephone and signal distribution. The junction boxes are placed 20 to 40 feet apart, depending upon the estimated density of wiring. The power and lighting circuits are generally fed by conduit from electric cabinets directly to the junction boxes while telephone and signal circuits are fed by ducts from wall cabinets.

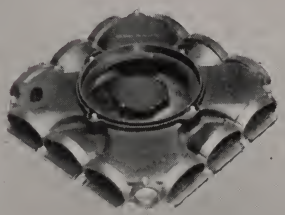


G-E FIBERDUCT and FITTINGS

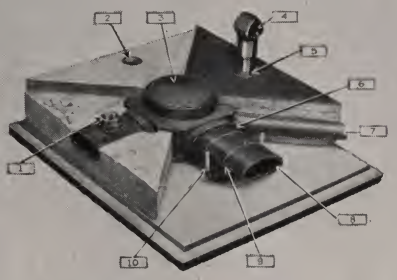
SP9005. Duct furnished in 5-foot lengths, with PRELOKAYLETS mounted on 24″ centers at the Factory.

Single Compartment Junction Box

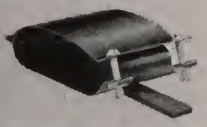
Double Duct Junction Box



Triple Junction Box



(1) G-E Fiberduct.
(2) Coupling-support with leveling screws.
(3) Oval crown 1 in. below surface molds strong concrete arch.
(4) Brass floor flange flush with linoleum.
(5) Lighting outlet, brass standpipe, bakelite head.
(6) Brass insert; grouted—cannot pull out.
(7) Adjustable-height cover recessed for linoleum.
(8) Brass insert threads into duct.
(9) Heavy, one-piece iron junction box with leveling screws.
(10) Conduit for feeder lines.



Single Coupling

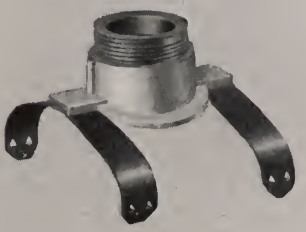
SP9310-A
Beveled Floor Flange

SP9331-A SP9340-A
Telephone Outlets

SP9040
Cross-under Fitting

SP9250
1″ Insert

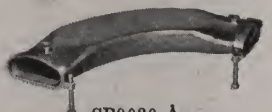
Prelokaylet—SP9295-B



Prelokaylet—SP9295-C

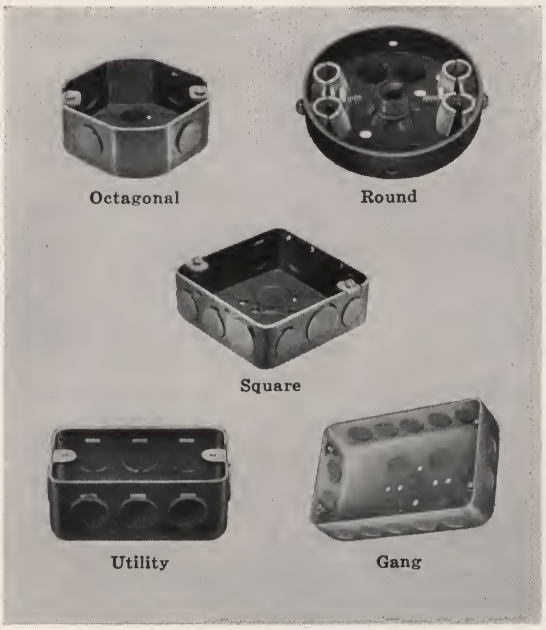
Linoleum Cover Assembly

SP9360-A SP9351-A
Lighting Outlets



SP9020-A
Floor Elbow

JUNCTION and OUTLET BOXES



ALL types of wiring systems, including armored cable, non-metallic sheathed cable, and systems run in rigid conduit, metallic tubing or underfloor ducts, must be connected at their outlets and at junction points (other than panelboards) in metal outlet or junction boxes of prescribed type. The principal types and their primary uses are:

1. **Octagon Boxes:** Made in 3¼″, 3½″, 4″ sizes with knockouts and fittings for rigid conduit, BX or BraidX. Various arrangements of knockouts and various provisions of fixture studs distinguish one unit from another. They come in depths of 1½″ and 2⅛″. These octagon boxes should be used for supporting fixtures other than switches on walls or ceilings, and as switch boxes where firm support or extra heavy service is desired.

2. **Round Boxes:** Made in 3¼″ and 4″ diameters with knockouts in bottoms and otherwise fitted for rigid conduit, BX or BraidX. Fixture studs optional. Made in shallow depths of ½″ and ¾″. They are used principally for mounting fixtures in plastered walls and ceilings, the depth of the box being equal to the depth of the plaster, permitting the boxes to be mounted with their backs on the surface of structural members that cannot be cut.

3. **Square Boxes:** Made in 4″ and 4 11/16″ sizes, and in 1½″ and 2⅛″ depths. Similar to Octagon boxes in all respects except shape. They are used for the same purposes where more space for switches, receptacles or other devices is required.

4. **Utility Boxes:** Made in various sizes and shapes, from 2⅞″ x 2″ x 1⅜″ deep to 4¼″ long, 2 7/16″ wide, 2 3/16″ deep. They are used primarily for exposed work, or as junction boxes, or to meet special requirements of size or shape.

5. **Gang Boxes:** Made in eight sizes for mounting from two to nine flush devices. They are used primarily for mounting switches and related devices in groups.

Covers of a wide variety of types are made for the foregoing boxes, adapting them to the many kinds of devices they may house, or to provide for pendant cords, surface mounted fixtures, etc.

Note: Architects and builders should require the use of boxes of the foregoing types for all outlets subject to constant service or heavy strain, including all fixtures, outlets and switches in frequent use. They also should be used for pull boxes and junction boxes. They should be used to the exclusion of sectional switch boxes (described below) in fireproof buildings and other structures of importance or quality as they provide a degree of strength and durability that cannot be expected of lighter sectional units.

Further, it is important that all boxes be firmly mounted on suitable metal hangers or cleats in all new work, and wherever practical in all alteration work. General Electric bar hangers, box cleats, adjustable box hangers or switch box supports and lath holders should be required in the specifications to provide suitable support and anchorage for all outlet boxes, according to the conditions of the installation.

6. **Sectional Switch Boxes:** Made in 3″ x 2″ and 3¾″ x 2″ units and in depths of 1½″, 2″, 2½″, 2¾″ and 3½″ for rigid conduit, BX and BraidX. These boxes can be combined in sections to form gang boxes in a wide range of combinations. They are suitable as switch outlet boxes and convenience outlet boxes with BX or BraidX installations, but should preferably not be used for mounting fixtures or heavy-duty appliances.

7. **Special Switch Boxes:** Include tandem switch boxes for 2, 3 or 4 gang switches mounted end to end. Door switch boxes for concealed door switches.

8. **Floor Boxes:** Made in many sizes and styles for flush mounting in floors of concrete or other masonry. They may be of adjustable or non-adjustable type—referring to leveling devices which facilitate their adjustment to the proper floor level—and in watertight or non-watertight types. Rectangular gang floor boxes for one to five gangs are also made for light, power and communication circuits.

9. **Concrete Boxes:** These are of octagonal pattern, 4″ in diameter and 2″, 3″, 4″, 5″ or 6″ deep. They are for embedding in concrete work, particularly in walls and ceilings.

10. **Spraguelets:** These are conduit bodies for mounting directly in a run of rigid conduit without other support and are used chiefly for exposed conduit installations. Three types of bodies—branch, shallow, and deep—serve a wide range of requirements when used with appropriate covers.

SWITCHES, SERVICE OUTLETS and PLATES

ALL normal lighting and power circuits terminate in an outlet box equipped with either a switch or a service outlet. The number and location of these switches and service outlets definitely influence the grade or quality of the wiring system.

TYPES OF SWITCHES

THE switches used in outlet boxes are commonly snap switches, of which there are three types—rotary, push-button, and tumbler switches. Of these three, the rotary and push-button types have largely been superseded by the tumbler switches because the latter are of simpler construction, of lower cost for equivalent grades, and are easier to operate. They are also superior in appearance.

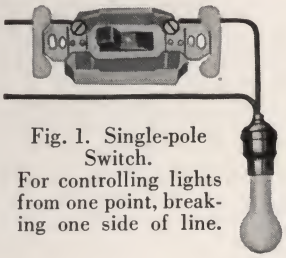


Fig. 1. Single-pole Switch. For controlling lights from one point, breaking one side of line.

Rotary Snap Switches are seldom used for ordinary "on" and "off" control of lights, except for open wiring or surface raceway installations of the cheapest type. They are more generally employed for the speed control and reversal of motors, such as for ventilating fans and for the control of circuits in electric ranges.

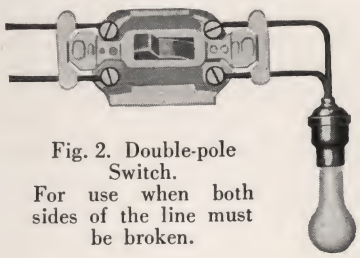


Fig. 2. Double-pole Switch. For use when both sides of the line must be broken.

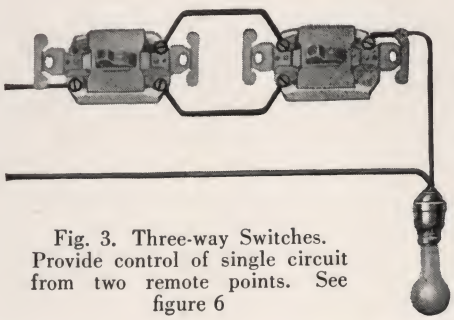


Fig. 3. Three-way Switches. Provide control of single circuit from two remote points. See figure 6

Push-type Switches are rapidly being superseded by tumbler type switches and, though still made, are practically obsolete.

The grades and types of tumbler switches, including mercury tube switches, are described later.

CONTROL OF CIRCUITS BY SWITCHES

OUTLET switches of all types (with a few exceptions) are made in the following forms:

Single-pole Switches break the circuit on one side only, as illustrated in Figure 1. A single-pole switch must not be placed in the grounded conductor of a circuit.

Double-pole Switches interrupt both sides of a circuit, as shown in Figure 2. They are required for three-wire circuits to open both sides of the circuit, and are also used on appliances, such as washing machines, ironers, and other units of relatively heavy capacity, because with the standard outlet plug the identified grounded wire of a circuit is lost in the flexible cord, and thus both sides of the circuit must be opened to avoid possibility of the device remaining alive.

Three-way Switches are single-pole switches designed for the control of a single circuit from two separate points. Either of the switches shown in Figure 3 will control the single lamp connected thereto.

Four-way Switches permit the control of a single circuit from more than two points. They are installed at the intermediate point between three-way switches, as shown in the diagram, Figure 6. With such a combination of three- and four-way switches, a single circuit may be controlled from any number of different points.

Two-circuit and Three-circuit Switches, sometimes called Electrolier Switches, are used for the control of lights in groups, or to control different degrees of heat or different motor speeds in other types of appliances. Their operation is diagrammatically shown in Figures 7 and 8.

GRADES OF TUMBLER SWITCHES

TUMBLER-TYPE switches are made in both surface and flush mounting styles. The surface mounting types are used with surface raceway installations where appearance is not a factor, and have the mechanism assembled to a porcelain base with a Textolite cover which encloses the mechanism. Flush tumbler switches are mounted within an outlet box and are made in the following grades:

Porcelain Box Flush Tumbler Switches. These switches are sturdy in construction and durable in performance. They are not as high in cost as the totally enclosed composition type. They should be specified where long service is desired and yet cost is a factor. More porcelain box switches are used than all other types and is the popular choice for most jobs. The mechanism is protected from the intrusion of harmful outside material by a dust cover of fiber which snaps in position.

Enclosed Flush Tumbler Switches have their mechanisms completely enclosed in a moulded compound or Textolite box. The mechanism is fully protected against mechanical damage while being installed, and the compound case is sufficiently resilient to withstand a great deal of me-

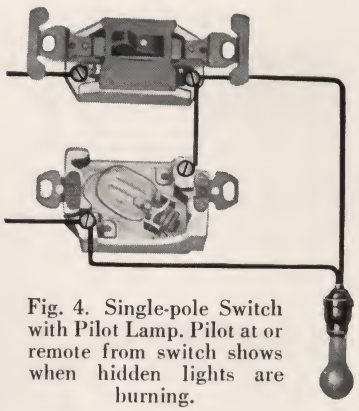


Fig. 4. Single-pole Switch with Pilot Lamp. Pilot at or remote from switch shows when hidden lights are burning.

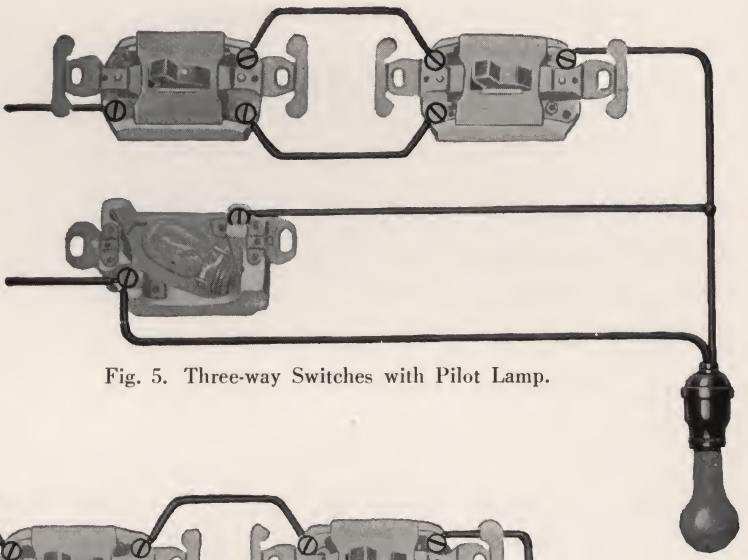


Fig. 5. Three-way Switches with Pilot Lamp.

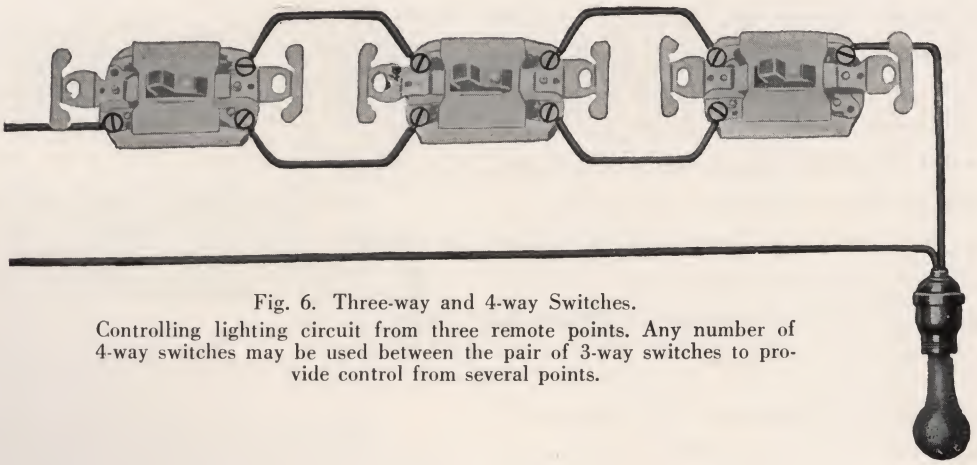


Fig. 6. Three-way and 4-way Switches.
Controlling lighting circuit from three remote points. Any number of 4-way switches may be used between the pair of 3-way switches to provide control from several points.

ELECTROLIER SWITCHES

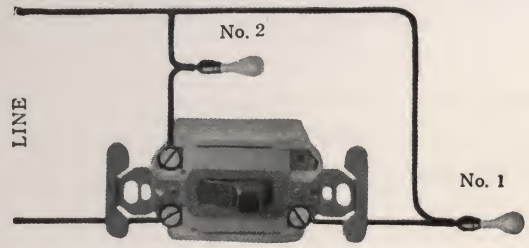


Fig. 7. Two-circuit Electrolier Switch. Controls two circuits in sequence by repeated throws of tumbler.

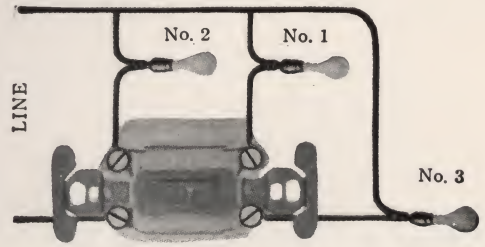


Fig. 8. Three-circuit Electrolier Switch. Controls three circuits in sequence or combinations by repeated throws of tumbler.

chanical abuse without failing. Terminals allow ample wiring room and wiring cannot interfere with switch operation.

Mercury Tube Flush Tumbler Switches are not of the snap switch type, but control the circuit by means of a Kon-nec-tor Mercury Tube. When this tube is tipped by the operation of the tumbler handle, the mercury flows over and electrically connects the open ends of the circuit. When the movement is reversed, the mercury flows away from the open ends and breaks the circuit. Since the mercury is contained in a sealed glass tube and since the switch moves without a mechanical snap mechanism, the operation is absolutely silent. Such switches are recommended for use in hospitals, nurseries, bedrooms, and in other locations where the sound of a snap switch might prove disturbing. They are made only in single-pole type.

Heavy Duty Tumbler Switches are made with totally enclosed mechanisms for mounting in standard deep type outlet boxes, and should be employed for controlling circuits up to and including 30 amperes capacity. Such circuits may include special power outlet circuits (other than range wiring circuits) in the kitchens and dining rooms of dwellings, or for showrooms and other heavy lighting loads in commercial buildings. They are designed to take No. 8 wire under the connecting screws. They are made in both single- and double-pole types and 3-way, and with ratings of 20 and 30 amperes at 250 volts.

Combination Flush Tumbler Switches consist of from one to three tumbler switches mounted in the same Textolite container or body. They are primarily designed as space

UNIT COMBINATIONS
SWITCH WITH OUTLET OR PILOT LAMP

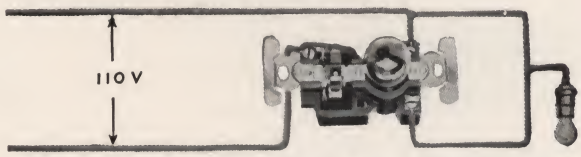


Fig. 9. Combination Switch and Pilot for Single Box. This compact unit, GE 2734, which shows a warning light at the switch when the circuit is closed, may be mounted in a single box.

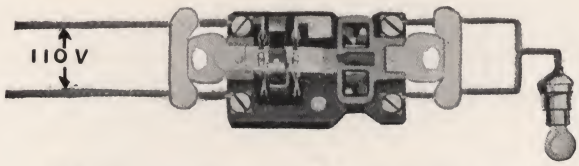


Fig. 10. Combination Flush Tumbler Switch and Convenience Outlet.
When wired as shown the switch controls both the light and the outlet. GE 2736.

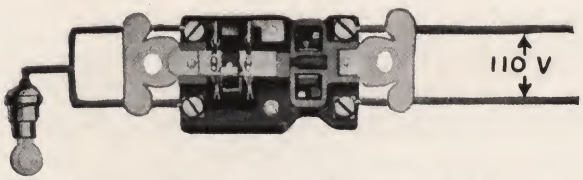


Fig. 11. Combination Flush Tumbler Switch and Convenience Outlet.
Same as Fig. 10 except that wired as shown the switch controls the light only, the outlet remaining live. Fits single switch box.

savers, permitting from one to three circuits of various types to be wired in a space normally taken by a single switch under a standard size plate.

Flush Locking Tumbler Switches are operated by a key instead of a tumbler handle, and are used for the control of lights for circuits in rooms open to the public or wherever it is desired to limit control to authorized persons only. They are made in all standard types.

SPECIAL SWITCHES

A WIDE variety of special types of switches are made for all service uses. Of these, the principal types in common use are the following:

G-E Automatic Door Switches are designed for installation in a door jamb and to operate automatically by the opening and closing of the door. Two different types are available. No. GE273 turns on the lights when the door is opened and cuts them off when the door is closed. This is used for closets and similar places where light is wanted while the door must remain open. No. GE274 turns on the lights when the door is closed and turns them off when the door is opened. A typical application is for telephone booths. Both types are enclosed in heavy shallow porcelain bodies and have a plunger equipped with a steel ballbearing tip which eliminates friction and strain.

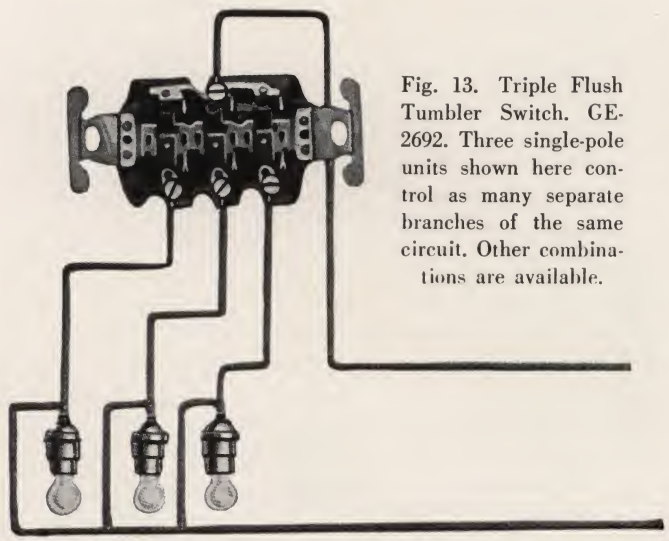


Fig. 13. Triple Flush Tumbler Switch. GE-2692. Three single-pole units shown here control as many separate branches of the same circuit. Other combinations are available.

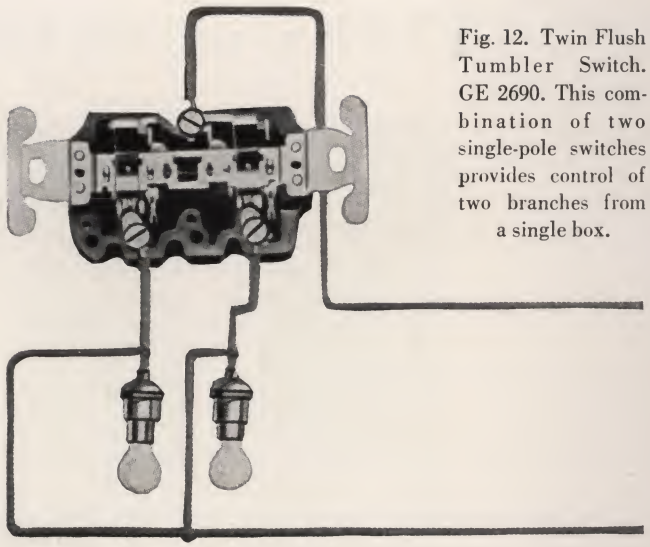


Fig. 12. Twin Flush Tumbler Switch. GE 2690. This combination of two single-pole switches provides control of two branches from a single box.

Other Special Switches are made in a variety of forms, including miniature tumbler switches, "pony" back-connected surface tumbler switches, and a complete line of heavy duty tumbler switches for panel or box cover mounting. Also canopy switches for lighting fixtures, including rotary, snap, and pull types are made in all required forms.

COMBINATION FLUSH TUMBLER SWITCHES

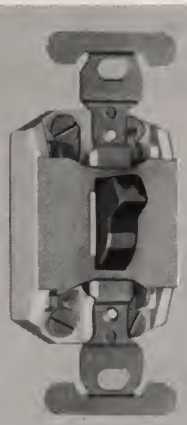
These wiring diagrams show typical connections for two of a large number of Combination Flush Tumbler Switches. All units in this series, a partial list of which is given on page 25, may be installed in a single switch box, providing the convenience of gang switches with utmost space economy.

NOTE:

In this manual only representative devices are illustrated. For catalogue numbers of many companion units see the General Merchandise Catalogue, available on request.

TYPES of SWITCHES

Single-Pole
GE 2841



Three-Way
GE 2514

Four-Way
GE 2515

GE 1756
Flush Locking
Tumbler Switch

GE 632
Single Pole
Push Button Switch

PORCELAIN BOX FLUSH TUMBLER SWITCHES

Single-Pole
GE 2842

Three-Way
GE 2593

Four-Way
GE 2596

ENCLOSED FLUSH TUMBLER SWITCHES

GE 273

GE 274

AUTOMATIC DOOR SWITCHES

Type GE 273 turns on lights when door is opened, for closets and similar situations. Type GE 274 turns off lights when door is open.

Single-Pole
GE 2923

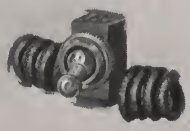
Double-Pole
GE 2924

Three-Way
GE 2925

HEAVY-DUTY FLUSH TUMBLER SWITCHES

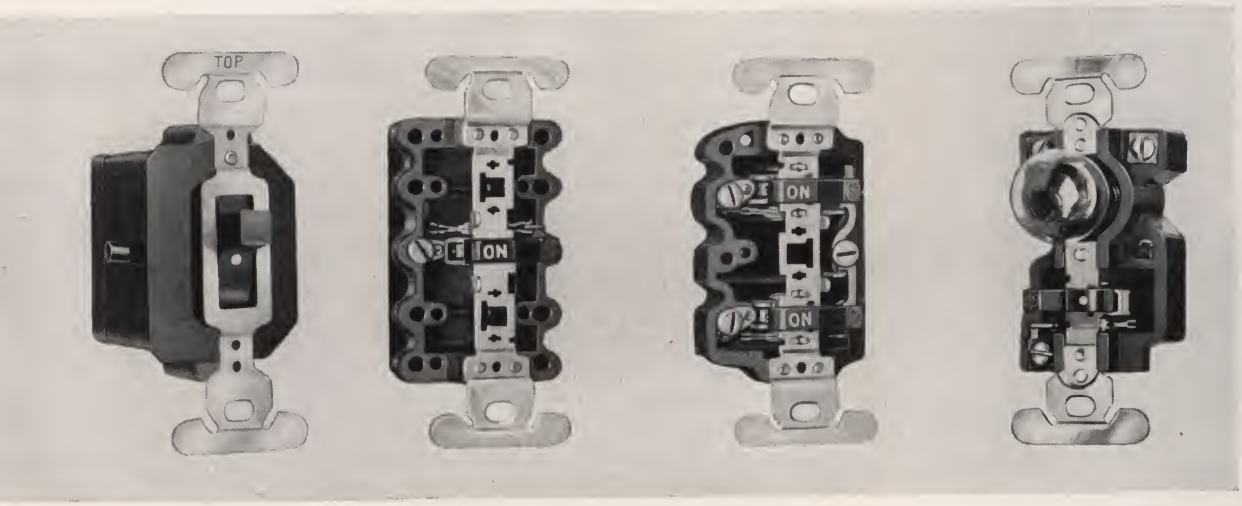
GE 2790
"Pony" Back Connected
Tumbler Switch

GE 2509
Canopy Pull
Switch



GE 2381
Canopy Tumbler
Switch

SPECIAL TYPES of SWITCHES



MERCURY TUBE
Flush Tumbler
Switch GE 2756

GE 2903

GE 2907

GE 2734

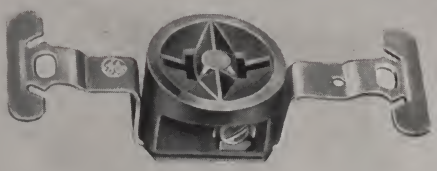
COMBINATION FLUSH TUMBLER SWITCHES

G-E COMBINATION FLUSH TUMBLER SWITCHES

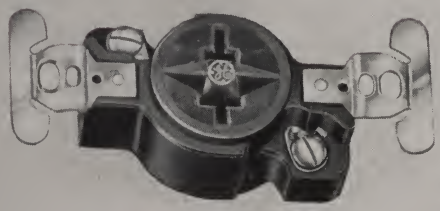
SCHEDULE S—N.E.C. STANDARD

Catalog Number	Description	Feed	Standard Package	Carton
GE2903	One Single-pole Unit		10	1
GE2904	One Three-way Unit		10	1
GE2905	One Double-pole Unit		10	1
GE2906	One Four-way Unit		10	1
GE2907	Two Single-pole Units	Common	10	1
GE2908	Two Single-pole Units	Separate	10	1
GE2909	One Single-pole and One Three-way	Common	10	1
GE2910	One Single-pole and One Three-way	Separate	10	1
GE2911	Two Three-way Units	Separate	10	1
GE2912	One Single-pole and One Four-way	Separate	10	1
GE2913	One Three-way and One Four-way	Separate	10	1
GE2914	Three Single-pole Units	Common	10	1
GE2915	Three Single-pole Units	Separate	10	1
GE2916	Two Single-pole and One Three-way	Common	10	1
GE2917	Two Single-pole and One Three-way	Separate	10	1
GE2918	One Single-pole, One Three-way, and One Four-way	Separate	10	1
GE2938	Two Three-way and One Single-pole		10	1

CONVENIENCE OUTLETS

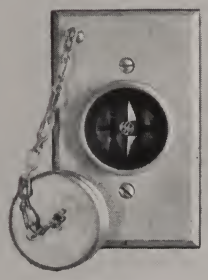


GE 2740
Side-Wired Single

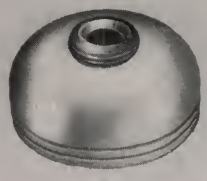


GE 2533
Top-Wired Single

GE 2254
Single Convenience



GE 2959
Protecting Cap
with Cord Hole
for Above Device



GE 2960
Outdoor Flush Receptacle

CONVENIENCE outlets are used to provide a means of connecting portable lamps and appliances to a live or switch control circuit by means of a flexible cord and connector. They are made in two basic grades only.

Side-wired Convenience Outlets, such as GE2740 (Single) and GE2679 (Double) represent the lower cost type with binding screws on the sides of a brown Textolite body.

Top-wired Outlets, made in a variety of forms, of which GE2553 (Single) and GE2534 (Double) are typical, provide binding screws accessible from the face of the outlet after the cover plate has been removed, and have correspondingly heavier Textolite bodies.

Single and Duplex Convenience Outlets. These are the common types employed on lighting outlets, as illustrated opposite. Single convenience outlets should be provided only where the outlet serves one appliance or device, such as an electric refrigerator, ventilating fan, or other semi-fixed unit of equipment. All other convenience outlets should be twin outlets.

G-E Flush Electric Wall Clock Hanger is a special outlet manufactured for supporting and connecting an electric wall clock. It is a one-piece unit, as illustrated on page 28.

Polarity Plugs and Receptacles consist of outlets and their connecting plugs, which are so designed that the polarity of the circuit is maintained through the flexible connecting cord. This is accomplished by arranging the prongs so that the plug can be inserted in only one way. Their advantage is to assure maintenance of a grounded wire from the circuit to the appliance which it serves. These units are made in double-, triple-, and four-pole types, and for light- and heavy-duty circuits.

Polarity plugs are normally employed for connecting appliances, motors, and devices having heavy current drains, and for units requiring three-wire or four-wire service.

Heavy-duty Units. A complete line of heavy-duty convenience outlets is provided for circuits carrying more than 15 amperes at 125 volts. These may be advantageously used on special power circuits in kitchens and dining rooms

in residences where the connected appliances may demand more than 500 watts each.

These new conditions can be met by providing special power circuits for outlets where such appliances are commonly employed, and by using with these power circuits appropriate G-E Heavy-Duty Outlet and Plugs.

This condition occurs even in the average residence when an electric toaster, drawing from 800 to 1,000 watts, and a coffee percolator, also drawing from 500 to 800 watts, are simultaneously connected to a single outlet in the kitchen or at the dining table. The total drain of two such units may readily exceed the wattage permitted on a single circuit under the National Electrical Code. It is significant that common household devices have been materially increased in their current consuming capacity in recent years, and that the simultaneous operation of two or more on a single circuit may readily overload a normal 15-amp., 110-volt circuit as permitted under the National Electrical Code.

G-E Range Outlet and Connector is discussed separately on page 30.

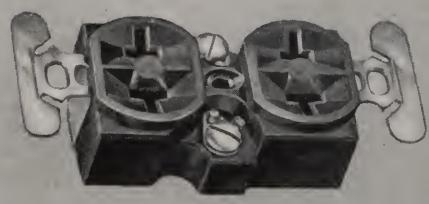
Floor Outlets and Plugs are made in a variety of forms for flush mounting in floors.

COMBINATION OUTLETS

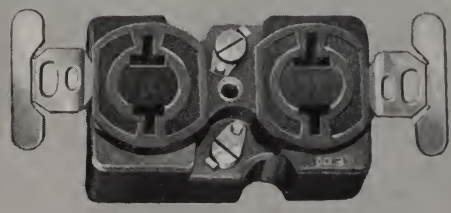
CONVENIENCE outlets may be combined with switches or pilot lights in a variety of forms. Typical units are illustrated on page 28.

Pilot Lights should be used with switches or with convenience outlets wherever it is desired to visibly indicate that the circuit is in use. Combined with a switch, they are employed for the remote control of circuits in garages or basements to indicate whether the light in these areas is on or off. Combined with convenience outlets, they visibly indicate when a connected appliance, such as an electric flatiron, water heater or curling iron, is drawing current. Combinations employing a switch, pilot light, and outlet may be arranged so that the switch controls both pilot light and

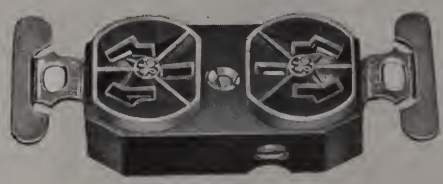
GE 2679
Side-Wired Double



GE 2534
Top-Wired Double

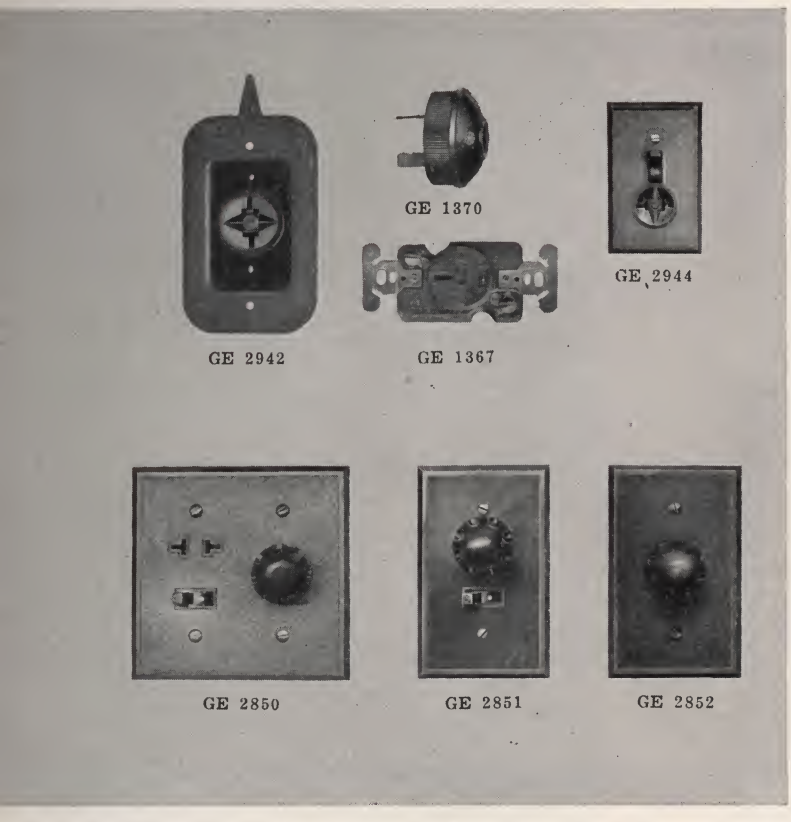


GE 2255
Twin Convenience



GE 2988
Double Duty Twin
Convenience Outlet

GE 2989
Double Duty Twin
Convenience Outlet
(No binding screw for ground)



GE 2942 Flush electric wall clock hanger outlet .

GE 1370 Polarity cap.

GE 1367 Flush polarity plug receptacle.

GE 2850 Combination flush tumbler switch, pilot lamp receptacle and convenience outlet.

GE 2851 Combination flush tumbler switch and pilot lamp receptacle.

GE 2852 Pilot lamp receptacle.

GE 2944 Heavy-duty switch and convenience outlet.

outlet, or either outlet or switch may be independent of the pilot light.

Outdoor Outlets consisting of a single convenience outlet mounted in a heavy cadmium plated flush plate, rubber seal gasket and weatherproof cap should be recommended for porches, etc. Their use together with weatherproof cap for the appliance lead give an outdoor outlet for use with appliances, for flood lighting, Christmas decorations, etc.

OUTLET PLATES

FLUSH plates for covering switches, convenience outlets, and floor outlets, are made of brass and Textolite in a variety of forms embracing all desired combinations. Typical units are illustrated and dimensions of standard plates and gang plates are indicated on page 29.

Brass Outlet Plates are made in three grades as follows: Solid plates are made of metal 0.100 inches thick, and are the highest grade brass plates obtainable. These plates are adaptable to DeLuX Grade Systems where brass plates are demanded. Heavy, stamped plates are 0.060 inches thick. These are standard quality plates, suitable for Supr-Kode Grade Systems, where a brass plate is desired for special reasons as noted below. Stamped brass plates 0.040 inches thick are the lightest grade plates made and are recommended only where economy is the paramount consideration.

The thickness is not marked on brass plates. Architects and owners should, therefore, guard against the substitution of Underwriters' minimum thickness plates where heavier metal has been specified.

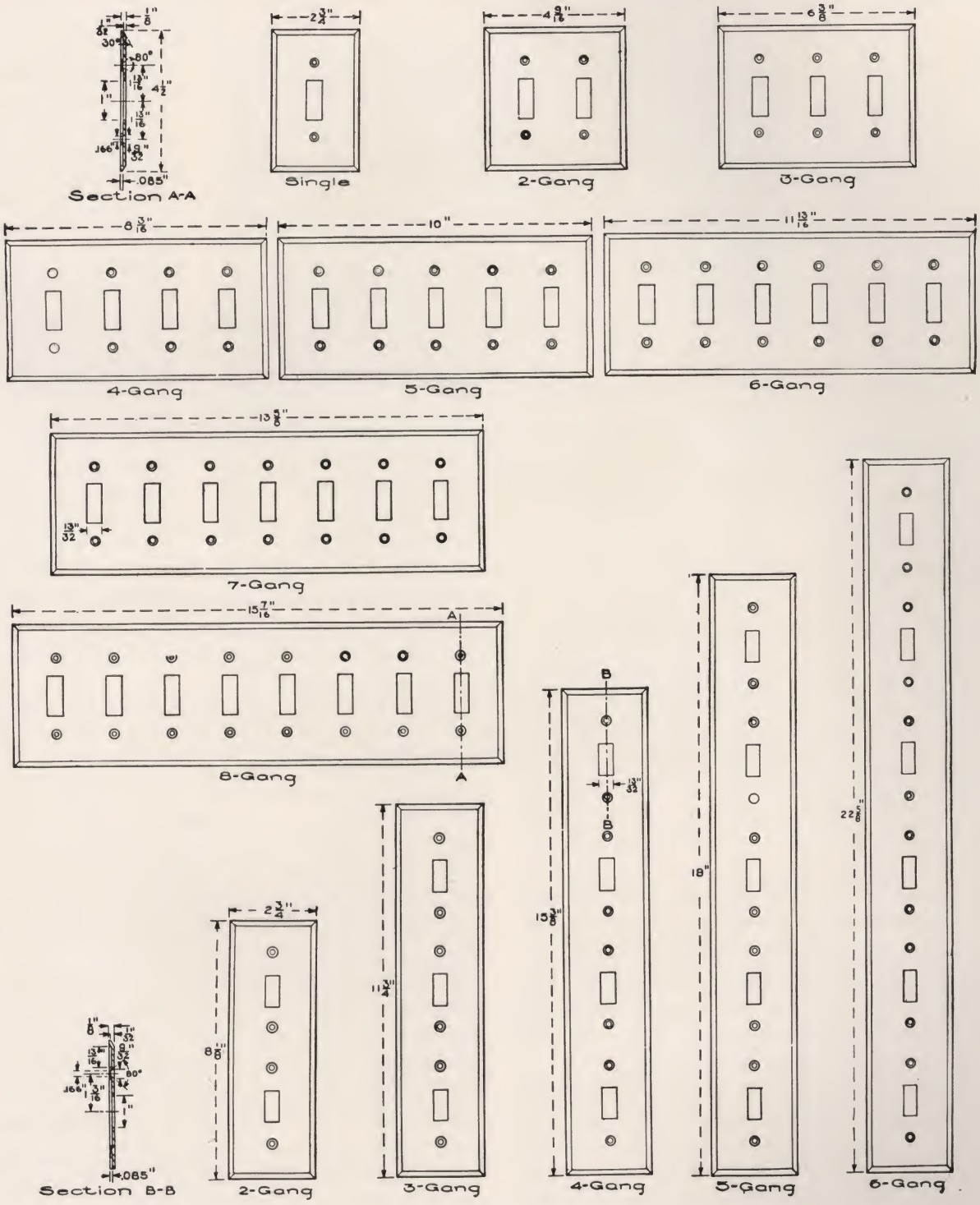
Brass plates have largely been superseded by Textolite plates, except where either the brass color or special color finishes are demanded by the decorative environment. Brass plates are normally supplied in a standard brush brass finish, but may be obtained in a wide variety of special finishes including colors. These special finishes are listed in the General Merchandise Catalogue.

Special Brass Plates may be obtained in the following styles: Special dimensions; plates with round corners and round edges; plates with round corners and beveled edges; plates with square edges; plates with raised edges; all of the foregoing being made only in 0.100 inch metal. Plates may also be obtained in special metals, such as bronze, Monel metal, etc. These are made on order. Flush plates may be engraved with identifying words or numbers deeply etched in block design of any desired height.

Textolite Plates have become the accepted standard because of their durability, freedom from tarnish or discoloration, and fine appearance. Textolite plates are made in black and brown Textolite, the brown being standard. For sizes and dimensions, see page 29.

Combination Plates are available in all thicknesses of brass and in Textolite to meet all possible combinations of switches, service outlets, and pilot lights. Gang plates are made up for any number of switches or outlets, and for combination switches, miniature switches, and pony switches. Typical combinations are illustrated on page 29.

G-E FLUSH PLATES (Dimensions)



NOTE:—The thicknesses of struck-up plates are 0.040 and 0.060 inches. The thickness of standard solid plates is 0.100 inches.

RANGE WIRING

IN every modern dwelling a special circuit should be provided to serve an electric cooking range. The rapid advance in the use of electricity for cooking purposes, and the fact that electric ranges must be served by a special power circuit with a capacity of 5 to 10 kw., makes it highly desirable to install the circuit during construction in order to save inconvenience and extra expense in providing connections when electric cooking may be desired by the owner or tenant.

Typical G-E Range Wiring Devices

G-E RANGE CONNECTION SET

THIS offers the most satisfactory method of connecting an electric range. It consists of a G-E Range Receptacle of triple-pole polarized type, made of strong black compound, and with fittings permitting connection to either rigid conduit, flexible steel armored conductors (BX), or non-metallic sheathed cable. Where the range is to be grounded, a grounding strap is assembled with the receptacle and its polarity plug.

To this receptacle there is attached either a G-E Unicord, shown as 49X234 above, or a G-E Range Connection Set, shown as 37X75. The Unicord set is made up of type "S" G-E Flex-Cord with all-rubber cap actually molded to the cord so that all connections are permanently sealed and protected. The end of the cord terminates in three separate wires, each provided with copper terminal lugs.

The G-E Range Connection Set is used with grounded ranges, and consists of a length of standard BX assembled by means of approved fittings to a standard triple-pole polarized cap. Grounding clips are provided for connection to the grounding strips on the G-E range receptacle. Copper terminal lugs are soldered to conductors at the other end for connection to the range.

The use of these G-E range wiring devices has two values. First, it meets the requirements of the National Electrical Code for providing a disconnect device in the range power circuit. The disconnect is accomplished by removing the plug from the G-E Range Receptacle and eliminates the need for any other special switch on this circuit. Second, the use of a range connection set permits the range to be removed for cleaning or redecorating walls, or refinishing floors beneath the range without calling in an electrician and without the use of tools. This portability is a highly desirable feature in all kitchens, except where the range may be permanently built into the structure.

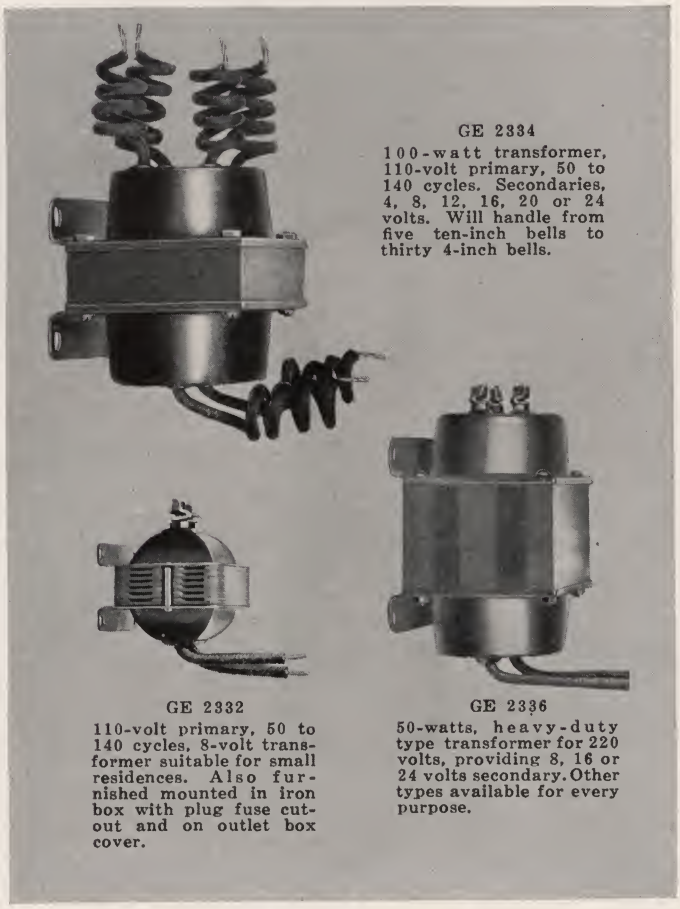
Another method of providing suitable range connections is to use a 40-amp. Three-wire Flush Receptacle (Cat. No. 6X542) and Plate (Cat. No. 6X548 or 6X541) in a standard 4-11/16" square box. The connection from receptacle to the range is made with a Three-blade Moulded Composition Plug (Cat. No. 6X540) and armored cable. The ground connection is made through the metallic sheath of the cable to two grounding blades which engage with the grounded metal receptacle plate. This arrangement is suitable for new construction where a flush job is desirable.

In choosing the location for the range receptacle care should be exercised to place it where it will be accessible after the range is in place, and to permit the range to be placed as close to the wall as possible. Ranges standing on legs should have the receptacle located between the rear legs in or above the baseboard. Ranges mounted on solid cabinet bases may have the receptacles mounted in a similar position, if accessible through the cabinet compartments; otherwise, the receptacle should be placed at either side of the range—preferably below the level of the cooking top.

LOW VOLTAGE WIRING MATERIALS

IN planning the electrical system of any building, consideration should be given to such low voltage circuits as are required for bell calls, annunciator, telephone, radio, burglar protection or fire alarm systems, and various control circuits such as for thermostats, water level control in service tanks, etc.

The materials used in these low voltage wiring systems should be of G-E manufacture throughout, and should be of substantially the same type as those employed for lighting circuits, except that the lower voltages employed may permit the use of smaller wire sizes. Materials specifically adapted to the various types of circuits are indicated as follows:



GE 2334
100-watt transformer, 110-volt primary, 50 to 140 cycles. Secondaries, 4, 8, 12, 16, 20 or 24 volts. Will handle from five ten-inch bells to thirty 4-inch bells.

GE 2332
110-volt primary, 50 to 140 cycles, 8-volt transformer suitable for small residences. Also furnished mounted in iron box with plug fuse cutout and on outlet box cover.

GE 2336
50-watts, heavy-duty type transformer for 220 volts, providing 8, 16 or 24 volts secondary. Other types available for every purpose.

Bell-Ringing Transformers

BELL AND ANNUNCIATOR WIRING

Conductors may be G-E Code Wire for Supr-Kode and G-E DeLuX Grade Systems, or G-E Rubber-covered Fixture Wire for Code Grade Systems. Where voltages less than 32 volts are employed, these wires do not need special mechanical protection in armored cable, metallic tubing, or rigid conduit, but there is a distinct advantage to be gained by the use of these products. Such wiring protects the circuits against mechanical injury or interruption of service through gnawing of insulation by rodents or through the hazards incident to construction and remodeling processes. At the same time, the use of a raceway of rigid conduit or electrical metallic tubing permits the repair, replacement, or extension of such circuits at a future date without disturbing the structure or finish of the building.

Transformers should be used to supply bell and annunciator circuits. One or more bell-ringing transformers should be installed at the service entrance or at some convenient panel board to provide low voltage current for bell, buzzer, and annunciator circuits.

TELEPHONE WIRING

WITH the constant growth of the use of telephones, and particularly of branch telephones in different parts of a residence, store, office building, or institutional structure, there has developed a definite need for preplanning of telephone installations, including the provision of raceways through which telephone wires to serve these extensions may be subsequently drawn or rearranged. While telephone companies provide the necessary wiring and wiring service in all buildings (except those equipped with private exchanges), they do so at the owner's cost and that wiring is largely surface wiring, unless raceways are provided for the owner to meet their requirements. G-E rigid Conduit and G-E Fibre Underfloor Duct systems are approved by all telephone companies as providing adequate raceways for telephone distribution circuits, and these should be approved in advance when planning the wiring layout of any building. Consult with your telephone company for sizes of raceways and distribution of outlets.

The same considerations hold for providing automatic exchanges within a building. G-E Telephone Wires should be specified for these circuits.

RADIO WIRING

IN all buildings where radios may be used, including particularly all dwellings, apartments, hotels, schools, hospitals, clubs and theatres, provision should be made for radio wiring of any of the following types:

Multiple Antenna Systems are employed in apartment buildings, hotels, schools, etc., where individual receiving sets are to be installed in different parts of the building. The multiple antenna system permits the use of a single

antenna to serve all such receivers. The wiring requires an antenna circuit connecting each receiver outlet, together with a ground circuit from each outlet to the ground. For types of materials, consult the manufacturer of the multiple antenna devices that are employed.

Audio-frequency Distribution Systems employ centralized radio receivers, each independently tuned to any desired station, and each distributing audio-frequency impulses to separate reproducers in various parts of the building. Such systems require antenna and ground wiring to the central receiving sets only, and from these one or more audio-frequency circuits, each enclosed in a separate rigid conduit raceway, to every speaker outlet. At this outlet, a switch and volume control provide for selective reception through any one of the centralized receivers. Where dynamic or power speakers are used, each audio-frequency outlet should be equipped also with a power outlet and switch. The use of rigid conduit for audio-frequency circuits is recommended for two reasons: First, it provides the necessary shield to the sensitive audio-frequency circuits, preventing interference with each other or by outside electrical disturbances. Second, the use of a raceway of this type permits the rearrangement and rewiring of these audio-frequency circuits to keep pace with the developments in radio and television reception. BX armored cable, if run in continuous lengths and with the metallic sheathing grounded, will provide the necessary shield of the audio-frequency circuits, but does not permit their future rearrangement should it become necessary.

Remote Control Wiring for Radios requires one or more cables extending from the control panels to the centralized receiver. These cables may consist of any number of wires, depending upon the number of positions in the control panel. These are low-tension circuits, and small wires may be employed but to provide flexibility in their installation or subsequent enlargement, rigid conduit raceways should be used wherever possible. Special outlet plates terminate these circuits and permit connection to flexible cables leading to the portable control panel.

PROTECTIVE AND CONTROL SYSTEMS

ALL burglar alarm, fire alarm, and similar protective systems should be wired in G-E Rigid Conduit, not only to provide the necessary mechanical protection of circuits against accidental injury, but also to make difficult malicious or deliberate interruption of service. Except in residences and for unimportant control systems, such as thermostats, hygrostats, water level indicators, these special circuits should also be wired in rigid conduit or in BX armored cable for similar reasons. Standard G-E Wiring Materials described elsewhere in relation to lighting and power circuits are normally employed for these protective and control circuits.

LOW VOLTAGE LIGHTING CIRCUITS

PRIVATE lighting plants frequently operate at relatively low voltage—under 50 volts. In order to provide adequate current for lighting and power purposes, the conductors, switches, and sockets must carry higher amperage than for equivalent units operating at 110 to 115 volts. Conductors and switches should be especially designed for the heavier currents employed, and all lamp sockets and receptacles should be of the 660 watt classification as noted later.

Lighting Outlets and Service Fixtures

ARCHITECTS and owners should give enough consideration to the specification of lampholders, lighting sockets, and service fixtures to make certain that these elements are of a grade consistent with the grades established throughout the rest of the wiring system. The choice should be made between porcelain-bodied, brass-bodied, or Textolite-bodied lampholders.

Porcelain Lampholders are primarily service fixtures for use where appearance is a negligible factor, or for excessively damp locations, or where exposed to corrosive fumes and are used in bathrooms, cellars, etc.

Brass Lampholders are made in two basic types—fluted catch and threaded catch.

Fluted Catch Sockets. Threaded-catch lampholders have the caps and bodies fastened together by a threaded ring, knurled to provide a handy grip. The cap cannot pull away from the shell and vibration will not loosen the parts. They should be used to support heavy fixtures, portable lamps, pendants, and other units subject to handling or vibration.

Textolite Sockets are used where sockets are subject to attack by the elements, or by the rigors of industrial use, and wherever moisture, steam or chemical fumes would quickly age a brass shell. These sockets have a fine appearance of moulded brown Textolite, with a highly lustrous finish. They are not only appropriate for use in rough surroundings, as in shops, factories, garages and cellars, but they may also be used to advantage for all sockets where the brown Textolite color is acceptable. Textolite sockets have the caps and bodies fastened together by a threaded ring similar to threaded-catch sockets with brass shells. The cap cannot pull away from the shell and vibration will not loosen the parts.

TYPES OF LAMPHOLDERS

LAMPHOLDERS are made with four types of operating mechanisms. They are (1) *keyless* lampholders for outlets under remote switch control; (2) *key-type* lampholders with a projecting key that is turned to operate a switch in the lampholder body; (3) *pull type*, in which

the bodies are equipped with a rotary switch operated by a pendant chain or cord; and (4) *push type*, having a switch operated by a "push through" button.

Sizes: Practically all lamps used in the United States at the present time are provided with the "Edison" screw-type base, which has been adopted as standard. This base is made in five sizes: Mogul, 1½" diameter; medium, 1" in diameter; intermediate, 21/32" in diameter; candelabra, ½" in diameter, and miniature, ⅜" in diameter. Mogul sockets are used for street lighting, theatre lighting, show window lighting using heavy wattages, factory lighting systems where gas-filled lamps of ratings up to and including 1500 watts must be served. The medium base is the type commonly used with incandescent lamps for 110- or 220-volt circuits, and will accommodate vacuum or gas-filled lamps up to and including 250 watts. Medium base sockets and receptacles rated at 660 watts are of a more rugged construction and will accommodate lamps up to and including 500 watts.

Intermediate and candelabra bases are used for small decorative lights and for signs. They are rated for 75 watts and 125 volts. The miniature base is used only for low voltage lamps such as are employed in portable flash lamps or Christmas tree lighting outlets, or similar purposes. They are not suitable for outdoor use.

Lampholders for Low Voltage Lighting Circuits. Lighting circuits operating at 50 volts or less require a greater current for equivalent energy than commercial 110-volt systems, and make necessary a greater amperage capacity in conductors, fittings, and sockets. The National Electrical Code requires standard lamp sockets and lamp receptacles in the 660-watt classification in all such low voltage lighting installations.

GE 2501
Key Socket
Multi-Catch
Fastening

GE 2676
Push Type

GE 1164
Pull Type

GE 777
Rosette Pull

GE 1836
Pull, Locking Body

GE 302
Pull Type

GE 1810
Pull, with
Shadeholder

GE 1642
⅛" Cap

GE 2708
Pull, with Insulated
Chain

GE 2751
Keyless, Textolite

GE 2609
Key ⅛" Cap

GE 2703
Key, Textolite
Threaded Catch

GE 2323
Keyless, Aluminum
Shell

GE 1210
Key, Porcelain

GE 1229
Porcelain Box Base

30857
Keyless, Porcelain
Pendant

GE 2581
Keyless, Porcelain
Enameled Box Cover

GE 721
Pull, with Short Chain
and 4" Linen Cord

GE 900
Keyless Mogul

All Numbers Are for Identification in General Merchandise Catalogue.

PART THREE

TIME-SAVER SPECIFICATIONS FOR G-E GRADED WIRING SYSTEMS

THE tables presented herewith make it easy to prepare a comprehensive specification that will assure the use of materials appropriate to the desired grade of the wiring system. While primarily concerned with the types of materials to be employed by the contractor, the tables also contain the basic design requirements of each grade of system. If the owner or architect does not undertake the complete design of the electrical system, the contractor who follows these Time-Saver specifications will necessarily install a system substantially in accordance with General Electric Standards.

To use these Time-Saver Specification Tables, copy into the specification the paragraph preceding the selected table, followed by the table itself. Or: Ask your nearest General Electric representative for separate copies of the selected tables and bind these copies into your specification. These copies are free. In either case, indicate on the drawings or in a supplementary specification paragraph the choice of product or finish where options are indicated in the Time-Saver Tables.

TIME-SAVER SPECIFICATIONS

Code Grade

Sheet No..... Date.....
Specification .....
.....
Architect .....
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TITLE .....

PAR. NO. .....of Specification designated above

G-E CODE GRADE WIRING SYSTEM

THE electrical contractor shall furnish and install all wiring materials necessary to complete the electrical installation hereinafter defined or indicated on the drawings, using wiring materials of General Electric manufacture throughout of types or grades of materials as designated in the following table. When the materials thus designated as Approved Standard Under Normal Conditions are not applicable to the conditions of the installation, the contractor shall install companion items of General Electric manufacture. All fittings and accessory materials not indicated in this table but necessary to complete the installation shall be furnished by the contractor as though herein defined in detail, and they shall be of a type or grade appropriate to the quality of specified parts. No substitutions of materials of another manufacture nor of a quality or type inferior to the typical item designated as standard shall be made without written permission of the architect or owner and a proper allowance made in the contract price.

Part of System or Location	Types or Grades of Materials Representing Approved Standard Under Normal Conditions
SERVICE ENTRANCES AND DISTRIBUTION CENTERS	
All Service Entrance Materials:	• Shall comply with requirements of local utility company. Unless contrary to regulations the following types shall be used:
Overhead Entrance, pole to building and between buildings:	• G-E Service Drop Cable or Weatherproof Wire.
Building Entrance to distribution center:	• G-E Service Entrance Cable or Code Wire in G-E Black Rigid Conduit.
Underground Entrances, pole to distribution center:	• Shall be G-E 600-volt Lead-sheathed Cable in G-E White Rigid Conduit, except where local regulations permit use of G-E Parkway Cable of type adapted to subsoil and installation conditions.
Meters and Service Equipment:	• G-E Watthour Meter and Trumbull Outdoor (or Indoor) Meter Box and Meter Service Switch of type designated by utility company.
Panel Boards:	• Shall consist of Trumbull Panel Boxes of sizes adequate to be served with G-E Tumbler Switches for Panel or Box Mounting such as GE269943 or GE235685, or G-E Entrance Switches and Fuses, such as GE42869 as required.
Bell Ringing Transformer:	• Shall be provided and installed on Panel Board of capacity adequate for the load indicated on the drawings, such as GE2332.

DISTRIBUTION MATERIALS

All Conductors:	• Shall be of G-E Code Grade Rubber-covered Wire, Flame-retarding Finish, unless otherwise noted.
Armored Cable:	• Shall be General Electric BX in dry locations, and BXL in damp locations.
Non-metallic Sheathed Cable:	• Shall be BraidX.
Rigid Conduit:	• Shall be G-E White or Black Rigid Conduit.
Electrical Metallic Tubing:	• Shall be G-E Electrical Metallic Tubing where designated on drawings.
Underplaster Extension Circuits:	• May be run in G-E Oval BX or G-E Oval Metallic Tubing where conditions require.
Outlet Boxes:	
Pull boxes and Junction boxes:	• Shall be G-E Stamped Steel Boxes with solid covers, such as Cat. No. SP52151.
Floor boxes in masonry floors:	• Shall be G-E Floor Boxes, such as Cat. No. SP8400 where waterproof adjustable boxes are required or Cat. No. SP8200 where waterproof, non-adjustable boxes will serve.
Floor boxes in wood joist floors:	Shall be G-E Utility Outlets, Cat. No. SP8000.
Outlet boxes for wall or ceiling fixtures:	Shall be G-E Octagonal or Square Boxes of suitable size, such as Cat. No. SP54151 or Cat. No. SP52151, mounted on suitable hangers if in stud construction, such as Cat. No. SP6602; except where conditions require shallow boxes, such as Cat. No. SP56121.
Switch boxes:	Shall be G-E Sectional Switch Boxes, such as Cat. No. SP6972.

SWITCHES, OUTLETS, PLATES

Switches:	
In living or public areas and frequently used service areas:	• Shall be G-E Single-pole, Compound Box Flush Tumbler Switches, such as GE2842.
In basements and secondary service areas:	• Shall be G-E Single-pole Flush Tumbler Switches, such as GE2841.
Step-Saver Switches:	• Shall be GE Three-way (and Four-way) Flush Tumbler Switches, such as GE2593 in living, public or primary service areas, and GE2514 in secondary service areas.
Door Switches:	• Shall be G-E Door Switches; either Cat. No. GE273 where light is on when door opens, or Cat. No. GE274 where light is on when door is closed; mounted in G-E Door Switch Boxes, Cat. No. SP6597.
Convenience Outlets:	• Shall be Top-wired Twin Convenience Outlets such as GE2534 or Side-wired Composition-body Outlets, such as GE2679, except where circuit is designed to serve but one appliance, when an equivalent single outlet shall be installed.
Portable Fixture Outlets: for fans, etc.	• Shall be G-E Fan Hanger Outlet, GE2755.
Electric Clock Outlets:	• Shall be G-E Electric Wall Clock Hanger Outlet, Cat. No. GE2942.
Switch and Convenience Outlet Plates:	
In living or public areas:	• Shall be Textolite except where brass plates are designated. Brass plates shall be .060" thick and in finishes elsewhere specified.
In service areas:	• Shall be Textolite or brass 0.40" thick in standard finish.

LAMPHOLDERS

Lampholders:	
In living or public areas:	• Shall be Brass Shell, Fluted-catch Lampholders except where Textolite Lampholders are designated.
Not subject to strain:	
Where subject to strain or frequent handling:	• Shall be Brass Shell, Threaded-catch Lampholders except where Textolite Lampholders are designated.
In service areas:	
Not subject to strain:	• Shall be G-E Porcelain-base Lampholders.
Where subject to strain or frequent handling:	• Shall be G-E Textolite Lampholders.
In all damp locations, and wherever insulated lampholders are required:	• Shall be G-E Textolite Lampholders.

SPECIAL CIRCUITS

Range Circuit:	• Shall be equipped with G-E Range Receptacle and a G-E Unicord, or a G-E Range Connection Cable, depending on grounding requirements.
Low Voltage Circuits:	
For bells, annunciators, thermostats, etc.:	• Shall be G-E Rubber Covered Fixture wire.
For public telephone extensions:	• Shall consist of G-E Black Rigid Conduit or G-E Electrical Metallic Tubing where conductors are subsequently to be installed by Telephone Company unless a G-E Underfloor Fiberduct system is provided.
For private telephones:	• Shall be G-E Telephone Wires run exposed except where BX or conduit circuits are indicated.
For protective, signaling, and line voltage control devices:	• Shall be run in G-E Black Rigid Conduit where tampering would endanger operation; otherwise in BX or Electrical Metallic Tubing as designated on drawings.
For Radio wiring:	
Shielded circuits:	• Shall be run in G-E Black Rigid Conduit or G-E Electrical Metallic Tubing where future changes require possible withdrawal of circuits, or shall be BX with sheathing grounded, as designated on drawings.
Non-shielded circuits:	• Shall be BraidX single conductors or cables.

TIME-SAVER SPECIFICATIONS

Supr-Kode Grade

Sheet No..... Date.....
Specification .....
.....
Architect .....
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TITLE .....

PAR. NO.....of Specification designated above

G-E SUPR-KODE GRADE WIRING SYSTEM

THE electrical contractor shall furnish and install all wiring materials necessary to complete the electrical installation hereinafter defined or indicated on the drawings, using wiring materials of General Electric manufacture throughout of types or grades of materials as designated in the following table. When the materials thus designated as Approved Standard Under Normal Conditions are not applicable to the conditions of the installation, the contractor shall install companion items of General Electric manufacture. All fittings and accessory materials not indicated in this table but necessary to complete the installation shall be furnished by the contractor as though herein defined in detail, and they shall be of a type or grade appropriate to the quality of specified parts. No substitutions of materials of another manufacture nor of a quality or type inferior to the typical item designated as standard shall be made without written permission of the architect or owner and a proper allowance made in the contract price.

Part of System or Location	Types or Grades of Materials Representing Approved Standard Under Normal Conditions
SERVICE ENTRANCES AND DISTRIBUTION CENTERS	
All Service Entrance Materials:	• Shall comply with requirements of local utility company. Unless contrary to regulations the following types shall be used:
Overhead Entrance, pole to building and between buildings:	• G-E Service Drop Cable or Weatherproof Wire.
Building Entrance to distribution center:	• G-E Service Entrance Cable or Code Wire in G-E Black Rigid Conduit.
Underground Entrances, pole to distribution center:	• Shall be G-E 600-Volt Lead-sheathed Cable in G-E White Rigid Conduit, except where local regulations permit use of G-E Parkway Cable of type adapted to subsoil and installation conditions.
Underground Distribution between buildings and for private street or garden lighting:	• Shall be G-E Parkway Cable of type designated on drawings, or, if not indicated, use Type RJ when installation method and soil conditions minimize mechanical hazards and dampness; Type RLJ under similar conditions except that soil is frequently wet; Type RLJIJ where cable is run under roadways or close to surface or in rocky soil, where extra mechanical protection is required; or Type RLJFJ when installation method; depth of laying or harsh rocky subsoil requires maximum mechanical protection and durability.
Meters and Service Equipment:	• G-E Watthour Meter and Trumbull Outdoor (or Indoor) Meter Box and Meter Service Switch of type designated by utility company.
Panel Boards:	• Shall consist of Trumbull Panel Boxes of sizes adequate for the number of circuits and spaces to be served with G-E Tumbler Switches for Panel or Box Mounting, such as GE269943 or GE235685, or G-E Entrance Switches and Fuses, such as GE42869, as required.
Bell Ringing Transformer:	• Shall be provided and installed on Panel board of capacity adequate for the load indicated on the drawings, such as GE2333.
DISTRIBUTION MATERIALS	
All Conductors:	• Shall be G-E Intermediate Grade Rubber-covered Wire Flame-retarding Finish, unless otherwise noted.
All Circuits:	• Shall use wire sizes computed for maximum voltage drop as follows: Feeder circuits, entrance to panel board 1½% drop (preferably 1½ volts maximum) based on appropriate demand factor allowed in "Minimum Specification for Adequate Wiring of Lighting Circuits" as referred to in G-E Supr-Kode Standards; branch circuits, panel board to outlet, 1½% drop (preferably 1½ volts maximum) based on connected load. No wire smaller than No. 12 B. & S. gauge shall be used. For runs of over 50 feet from panel board to first outlet no wire smaller than No. 10 shall be used for that portion of the circuit, and none smaller than No. 12 between outlets. Runs exceeding 100 feet shall be avoided wherever practicable. Convenience outlet shall not be placed on the same circuit with outlets for general illumination. All lighting circuits shall be designed for 15 ampere load, but shall be sufficient in number so that the initial load shall not exceed 1000 watts except in the case of a single lamp of larger size.
In fireproof buildings, new work:	• Shall be run in G-E White Rigid Conduit.
In non-fireproof buildings, new work:	• Unless otherwise shown on drawings all main feeders and branch feeders to junction boxes, all power circuits and all circuits exposed in basements shall be run in G-E White Rigid Conduit; minor branch and switch circuits shall be run in BX in dry locations or BXL in damp locations.
All buildings, old work, underplaster extensions:	• May be run in G-E Oval BX or G-E Oval Metallic Tubing where conditions require.

Power Circuits:	• Shall be designed for the maximum load likely to be connected; those terminating in receptacles shall be distinguished from ordinary convenience outlet circuits by being equipped with polarity receptacles.
Outlet Boxes:	
Pull boxes and Junction boxes:	• Shall be G-E Stamped Steel Boxes with solid covers, such as Cat. No. SP52151.
Floor boxes in masonry floors:	• Shall be G-E Floor Boxes such as Cat. No. SP8400 where weatherproof adjustable boxes are required, or Cat. No. SP8200 where waterproof, non-adjustable boxes will serve.
Floor boxes in wood joist floors:	• Shall be G-E Utility Outlets, Cat. No. SP8000.
Outlet boxes for wall or ceiling fixtures:	• Shall be G-E Octagonal or Square Boxes of suitable size, such as Cat. No. SP54151 or Cat. No. SP52151, mounted on suitable hangers if in stud construction, such as Cat. No. SP6602; except where construction conditions require Shallow Boxes such as Cat. No. SP56121.
Switch Boxes:	• Shall be G-E Sectional Switch Boxes such as Cat. No. SP6972.
SWITCHES, OUTLETS, PLATES	
Switches:	
In all locations except as noted below:	• Shall be G-E Single-pole Compound Box Flush Tumbler Switches, such as GE2842.
Step-Saver Switches:	• Shall be used to control at least one light in every space served by two doors more than ten feet apart, in all stair halls, between main building and garage or outbuildings, and shall be G-E Three-way Flush Tumbler Switches, such as GE2593 with equivalent Four-way Switches as required.
Silent Switches:	• Shall be used where designated on drawings (in living or bedrooms, hospital rooms, etc., where silent operation is desired) and shall be G-E Mercury Tube Flush Tumbler Switches, Cat. No. GE2756.
Double-pole Switches:	• Shall be used on circuits controlling appliances drawing more than 1500 watts, on circuits serving convenience outlets designed for ungrounded appliances drawing over 1500 watts, and on all 3-wire circuits, and shall be equivalent to Cat. No. GE2846.
Heavy Duty Switches:	• Where indicated on drawings shall be G-E Heavy-duty Tumbler Switches, Cat. No. GE2923 type as required.
Special Switches:	
Combination Switches:	• Shall be Cat. No. GE2903 or any combination in this series as required; Switch and Pilot Light Combination Cat. No. GE2734, or Switch and Outlet Combination Cat. No. GE2736 or their equivalent, where indicated on drawings.
Door Switches:	• Shall be G-E Door Switches; either Cat. No. GE273 where light is on when door opens, or Cat. No. GE274 where light is on when door is closed; mounted in G-E Door Switch Boxes, Cat. No. SP6597.
Convenience Outlets:	• Shall be Top-wired Twin Convenience Outlets such as GE2534, except where circuit is designed to serve but one appliance, when an equivalent single outlet shall be installed.
Portable Fixture Outlets: for fans, etc.	• Shall be G-E Fan Hanger Outlet GE2755.
Electric Clock Outlets:	• Shall be G-E Electric Wall Clock Hanger Outlet, Cat. No. GE2942.
Switch and Convenience Outlet Plates:	
In all outlets:	• Unless brass plates are designated, all switch and outlet plates shall be Textolite. Where brass plates are designated they shall be .060″ thick in service and secondary living or public areas and solid plates .10″ thick in main living and public areas, finished as elsewhere specified.
LAMPHOLDERS	
Lampholders:	
In all locations:	
Not subject to handling or strains:	• Shall be Textolite Lampholders except where brass shells are designated and these shall be Brass Shell Fluted-catch Lampholders.
Subject to frequent handling or strain:	• Shall be Textolite Lampholders except where brass shells are designated and these shall be Brass Shell Threaded-catch Lampholders.
Subject to dampness:	• Shall be G-E Textolite Lampholders.
SPECIAL CIRCUITS	
Range Circuit:	• Shall be equipped with G-E Range Receptacle, and a G-E Unicord, or a G-E Range Connection Cable, depending on grounding requirements.
Low Voltage Circuits:	
For bells, annunciators, thermostats, etc.:	• Shall be G-E Rubber Covered Fixture Wire.
For public telephone extensions:	• Shall consist of G-E White Rigid Conduit where conductors are subsequently to be installed by Telephone Company unless a G-E Underfloor Fiberduct system is provided.
For private telephones:	• Shall be G-E Telephone Wires run exposed except where conduit circuits are indicated.
For protective, signaling and line voltage control devices:	• Shall be run in G-E White Rigid Conduit where tampering would endanger operation; otherwise in BX as designated on drawings.
For Radio wiring:	
Shielded circuits:	• Shall be run in G-E White Rigid Conduit where future changes require possible withdrawal of circuits, or shall be BX with sheathing grounded as designated on drawings.
Non-shielded circuits:	• Shall be BraidX single conductors or cables.

TIME-SAVER SPECIFICATIONS

DeLuX Grade

Sheet No..... Date.....
Specification .....
.....
Architect .....
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TITLE .....

PAR. NO.....of Specification designated above

G-E DeLuX GRADE WIRING SYSTEM

THE electrical contractor shall furnish and install all wiring materials necessary to complete the electrical installation hereinafter defined or indicated on the drawings, using wiring materials of General Electric manufacture throughout of types or grades of materials as designated in the following table. When the materials thus designated as Approved Standard Under Normal Conditions are not applicable to the conditions of the installation, the contractor shall install companion items of General Electric manufacture. All fittings and accessory materials not indicated in this table but necessary to complete the installation shall be furnished by the contractor as though herein defined in detail, and they shall be of a type or grade appropriate to the quality of specified parts. No substitutions of materials of another manufacture nor of a quality or type inferior to the typical item designated as standard shall be made without written permission of the architect or owner and a proper allowance made in the contract price.

Part of System or Location	Types or Grades of Materials Representing Approved Standard Under Normal Conditions
SERVICE ENTRANCES AND DISTRIBUTION CENTERS	
All Service Entrance Materials:	• Shall comply with requirements of local utility company. Unless contrary to regulations the following types shall be used:
Underground Entrances, pole to distribution center:	• Shall be G-E 600-volt Lead-sheathed Cable in G-E White Rigid Conduit, except where local regulations permit use of G-E Parkway Cable of type adapted to subsoil and installation conditions.
Underground Distribution between buildings and for private street or garden lighting:	• Shall be G-E Parkway Cable of type designated on drawings, or, if not indicated, use type RJ when installation method and soil conditions minimize mechanical hazards and dampness; Type RLJ under similar conditions except that soil is frequently wet; Type RLJIJ where cable is run under roadways or close to surface or in rocky soil, where extra mechanical protection is required; or Type RLJFJ when installation method, depth of laying or harsh rocky subsoil requires maximum mechanical protection and durability.
Meters and Service Equipment:	• G-E Watthour Meter and Trumbull Outdoor (or Indoor) Meter Box and Meter Service Switch of type designated by utility company.
Circuit Breakers:	• Shall be G-E Circuit Breakers, Type AF-1, of proper rating, and shall be used instead of fuses at all points requiring overload protection.
Panel Boards:	• Shall consist of Trumbull Panel Boxes of sizes adequate for the number of circuits and spaces to be served with G-E Tumbler Switches for Panel or Box Mounting, such as GE269943 or GE235685, or G-E Entrance Switches with G-E Circuit Breakers, Type AF-1.
Bell Ringing Transformer:	• Shall be provided and installed on Panel Board of capacity adequate for the load indicated on the drawings, such as GE2336 or GE2337.
DISTRIBUTION MATERIALS	
All Conductors:	• Shall be G-E 30% Performance Grade Rubber-covered Wire Flame-retarding Finish, unless otherwise noted.
All Circuits:	• Shall use wire sizes computed for maximum voltage drop as follows: Feeder circuits, entrance to panel board, 1% drop (preferably 1 volt maximum) based on appropriate demand factor allowed in "Minimum Specification for Adequate Wiring of Lighting Circuits" as referred to in G-E Supr-Kode Standards; branch circuits, panel board to outlet, 1% drop (preferably 1 volt maximum) based on connected load. No wire smaller than No. 12 B. & S. gauge shall be used. For runs of over 35 feet from panel board to first outlet no wire smaller than No. 10 shall be used for that portion of the circuit, and none smaller than No. 12 between outlets. Runs exceeding 75 feet shall be avoided wherever practicable. Convenience outlets shall not be placed on the same circuit with outlets for general illumination. All lighting circuits shall be designed for 15 ampere load, but shall be sufficient in number so that the initial load shall not exceed 1000 watts except in the case of a single lamp of larger size.
In all buildings:	• Shall be run in G-E White Rigid Conduit, except where installation conditions require the use of G-E Galvanized Flexible Metallic Conduit and when branch circuits are run in G-E Underfloor Fiberduct. All rigid conduit shall be of sizes adequate to permit future installation of wires of double the capacity of those initially installed. G-E Underfloor Fiberduct shall be installed with appropriate fittings in all masonry floors except basement floors, disposing the runs as indicated upon the drawings.
Outlet Boxes: Pull boxes and Junction boxes:	• Shall be G-E Stamped Steel Boxes with solid covers, such as Cat. No. SP52151.

Floor boxes in masonry floors:	• Shall be G-E Floor Boxes such as Cat. No. SP8400 where weatherproof adjustable boxes are required, or Cat. No. SP8200 where waterproof, non-adjustable boxes will serve.
Floor boxes in wood joist floors:	• Shall be G-E Utility Outlets, Cat. No. SP8000.
Outlet boxes for wall or ceiling fixtures:	• Shall be G-E Octagonal or Square Boxes of suitable size, such as Cat. No. SP54151 or Cat. No. SP52151, mounted on suitable hangers if in stud construction, such as Cat. No. SP6602; except where construction conditions require Shallow Boxes such as Cat. No. SP56121.
Switch Boxes:	• Shall be G-E Square or Gang Boxes (not sectional) of suitable size.
SWITCHES, OUTLETS, PLATES	
Switches:	• Shall be G-E Single-pole Compound Box Flush Tumbler Switches, such as GE2842.
In all locations except as noted below:	
Step-Saver Switches:	• Shall be used to control at least one light in every space served by two doors more than ten feet apart, in all stair halls, between main building and garage or outbuildings, and shall be G-E Three-way Flush Tumbler Switches, such as GE2593 with equivalent Four-way Switches as required.
Silent Switches:	• Shall be installed in all main living areas in dwellings, including main halls, bedrooms, nurseries, libraries, living and dining rooms; in private offices in commercial buildings; in all bedrooms and wards in hospitals; and in all libraries and classrooms in schools; and in other locations specifically indicated in the drawings where silent switch operation is desired; and these switches shall be G-E Mercury Tube Flush Tumbler Switches, Cat. No. GE2756.
Double-pole Switches:	• Shall be used on circuits controlling appliances drawing more than 1000 watts, on circuits serving convenience outlets designed for ungrounded appliances drawing over 1000 watts, and on all three-way circuits, and shall be equivalent to Cat. No. GE2846.
Heavy Duty Switches:	• Shall be used in all locations subject to constant use and shall be equivalent to GE2923 type as required.
Special Switches:	
Combination Switches:	• Shall be Cat. No. GE2903 or any combination in this series as required; Switch and Pilot Light Combination Cat. No. GE2734, or Switch and Outlet Combination Cat. No. GE2736 or their equivalent, where indicated on drawings.
Door Switches:	• Shall be G-E Door Switches; either Cat. No. GE273 where light is on when doors opens, or Cat. No. GE274 where light is on when door is closed; mounted in G-E Door Switch Boxes, Cat. No. SP6596.
Convenience Outlets:	• Shall be Top-wired Twin Convenience Outlets such as GE2534, except where circuit is designed to serve but one appliance, when an equivalent single outlet shall be installed.
Power Outlets:	• Shall be G-E Polarity Receptacles such as Cat. No. GE966 for two-wire circuits, Cat. No. GE2762 for three-wire circuits, and Cat. No. GE2777 for four-wire circuits.
Portable Fixture Outlets: for fans, etc.:	• Shall be G-E Fan Hanger Outlet, Cat. No. GE2755.
Electric Clock Outlets:	• Shall be G-E Electric Wall Clock Hanger Outlet, Cat. No. GE2942.
Switch and Convenience Outlet Plates:	• Unless brass plates are designated, all switch and outlet plates shall be Textolite.
In all outlets:	Where brass plates are designated they shall be .060″ thick in service and secondary living or public areas and solid plates .10″ thick in main living and public areas, finished as elsewhere specified.
LAMPHOLDERS	
Lampholders:	
In all locations:	
Not subject to handling or strains:	• Shall be Textolite Lampholders except where brass shells are designated and these shall be Brass Shell Fluted-catch Lampholders.
Subject to frequent handling or strain:	• Shall be Textolite Lampholders except where brass shells are designated and these shall be Brass Shell Threaded-catch Lampholders.
Subject to dampness:	• Shall be G-E Textolite Lampholders.
SPECIAL CIRCUITS	
Range Circuit:	• Shall be equipped with G-E Range Receptacle and a G-E Unicord, or a G-E Range Connection Cable, depending on grounding requirements.
Low Voltage Circuits:	
For bell, annunciators, thermostats, etc.:	• Shall be G-E Rubber Covered Fixture wire.
For public telephone extensions:	• Shall consist of G-E White Rigid Conduit where conductors are subsequently to be installed by Telephone Company unless a G-E Underfloor Fiberduct system is provided.
For private telephones:	• Shall be G-E Telephone Wires run exposed except where conduit circuits are indicated.
For protective, signaling and line voltage control devices:	• Shall be run in G-E White Rigid Conduit where tampering would endanger operation; otherwise in BX as designated on drawings.
For Radio wiring:	• Shall be run in G-E White Rigid Conduit where future changes require possible withdrawal of circuits, or shall be BX with sheathing grounded as designated on drawings.
Shielded circuits:	
Non-shielded circuits:	• Shall be BraidX single conductors or cables.

APPENDICES

I. IDENTIFICATION OF G-E WIRING MATERIALS

THE care exercised by the General Electric Company in the manufacture of its equipment, and by the architect or owner in its careful selection according to these General Electric Wiring Systems, warrants the exercise of equal care to be certain that the chosen products are installed without the substitution of inferior products regardless of their manufacture. Insistence upon G-E products is one of the first and simplest safeguards of the pre-selected standard of quality. Each G-E product, in its respective field, complies with National Electrical Code requirements and exceeds these requirements by a liberal margin, assuring the user of maximum service and satisfaction.

To assist in the identity of General Electric products, all types are marked or distinguished from products of other manufacture by well-defined and easily remembered methods. These are:

Cables and Conductors: To identify G-E Building Wires and Cables, look for parallel red and black thread woven in the braid, or two black and one red thread laid parallel to the Conductor directly beneath the braid.

G-E Rigid Conduit: Each length of G-E Rigid Conduit, whether white or black, is clearly marked by pasted labels. Fittings are stamped with the G-E symbol.

All Other G-E Wiring Materials: Switches, Switch Plates, Convenience Outlets, and other wiring devices are clearly identified by the G-E symbol on the unit. Look for the famous G-E monogram. It is your only assurance against substitution.

II. INSPECTION OF G-E GRADED WIRING SYSTEMS

THE architect or owner who has specified General Electric Wiring Materials according to any of the three grades herein established is advised to inspect the installation immediately after the contractor starts work, and at that time to examine the supplies delivered by the contractor to the job. Wire and cable in coils and on reels will carry the G-E label on the wrappings, and all outlet boxes, switches, convenience outlets, conduit, and other supplies will be similarly identified not only as to source of manufacture, but also the fixtures and fittings will carry the respective catalogue numbers. If any of the supplies are found to be of other than G-E manufacture, the contractor should be required to remove them before proceeding with the work, unless written permission has been given in advance to make substitutions. Only in this way can rigid adherence to these standards be assured with the consequent maximum satisfaction throughout years of use.

A second inspection should be made during the process of installation and before the work is more than half completed. Discarded packages found at the site should be examined for identification of the products they contained and again a check made on the contractor's materials if unapproved products appear to be in use by the contractor. All visible parts of the wiring system may be similarly inspected for the G-E trademark or label.

These intermediate inspections should be repeated at intervals, especially where substitutions have been found, to make sure that the contractor has replaced the substitutes with genuine General Electric products.

A final inspection should be made before the architect's certificate is issued, not only to check the operation of all switches and the connection of all outlets to their proper circuits and fuses, but also to ascertain that switch plates, Elexits, lampholders and other fittings installed in the final stages comply with the original specifications.

It should be remembered that the certificate of approval issued by the local inspecting organization merely indicates compliance with the National Electrical Code and local regulations, and in nowise relates to the quality of materials or workmanship beyond the safety requirements of these codes and ordinances.

DEPENDABLE PRODUCTS AT NO ADDED COST

This insistence upon G-E products in nowise adds to the cost of a wiring system as all G-E products are priced competitively with other devices of equal grade and quality. The only incentive which a contractor may have to substitute materials of other manufacture for those specified under the G-E wiring system standards is to cheapen the system at the owner's cost by the use of *inferior* grades. It has already been noted that General Electric manufactures products to suit each grade requirement, but it never sells or represents a product designed merely to meet Code requirements as of any superior grade or quality than the original purpose indicates.

III. DETERMINATION OF WIRE SIZES

ONE of the most important factors in securing satisfactory electrical service is the relation of the size of wire to the load carried. This involves not only the actual wire size employed, but also how the total load is divided into separate circuits.

The flow of electricity through a conductor is analogous to the flow of water through a garden hose. It is common experience that if a short length of garden hose is employed the water flows through with no appreciable loss of pressure, but if the length of hose is greatly increased without correspondingly increasing its size a marked drop in pressure is always noticed. The amount of electrical power transmitted by a given size of wire likewise diminishes as the length of the wire increases.

This analogy to electrical conductors is too seldom appreciated. The National Electrical Code establishes minimum wire sizes which give loads on the basis of protection only; that is, the sizes are computed so that for the given load in amperes the wire will not become overheated and thus constitute a potential fire hazard. If No. 14 wire will carry 12 amperes a distance of 10 feet without becoming overheated, it is obvious that it will carry the same number of amperes 100 or 1000 feet without becoming any hotter than for the short run. But if a pressure of 110 volts is impressed on the 10-foot circuit at one end, the resistance of the wire (comparable to the friction in the garden hose) will not appreciably reduce the voltage delivered at the other end in so short a length. If the same voltage were impressed on a circuit 100 feet in length the resistance would be such that less than 107 volts would be delivered, and in the case of 1000-foot circuit there would only be 78.8 volts available for the operation of lights or appliances.

In good wiring practice, therefore, it is essential that the length of the circuit, measured in feet from distribution center to point of load, be considered as well as the number of amperes carried in determining the size of wire to employ. The failure of the National Electrical Code to take into consideration the drop in potential in circuits of various lengths had led to a general adoption of the wire sizes permitted by the Code on the basis of safety only. The result has been to cause incalculable losses to the users of electricity, for they pay in the meter not only for the current actually consumed by the device but for all that is lost in overcoming the resistance of the distribution circuits.

Another factor to take into consideration when planning wiring layouts is the probability of future demand for heavier current consumption than is normally required today. The history of the electrical industry has shown a steady increase in the consumption of current resulting from higher standard of lighting efficiency and wider applications of electrical power and heating devices. It is not safe to assume that the ultimate has been reached. Therefore, all wiring systems should be designed to permit a future increase in load. This may be accomplished by providing spare circuits to take care of future loads, and by using wire sizes in excess of immediate requirements.

METHOD OF COMPUTING WIRE SIZES

THE proper size of wire required to carry a current any distance, with a given loss in volts, can be determined from the following table based on Ohm's law.

$$\frac{\text{Length of run in feet} \times \text{amperes} \times 21.5}{\text{Volts lost}} = \text{Circular Mils}$$

In this formula the number of feet must be measured one way, not both sides of the circuit; volts lost should be taken as the drop allowed in volts, and circular mils show the size of wire to use.

Example: What size wire should be used on a 250-volt circuit where it is necessary to carry 150 amperes a distance of 300 feet to a center of distribution with a loss of 3 per cent under full load?

$$\frac{300 \times 150 \times 21.5}{7.5}$$

= 129,000 circular mils, or No. 00 B. & S. gauge which is the next size heavier.

NUMBER OF CIRCUITS

UNDER the National Electrical Code branch circuits may not carry loads in excess of 1500 amperes each. This standard is based on safety requirements only and does not take into consideration the probability of future demands for loads in excess of present requirements. Modern practice demands that branch circuits be designed to carry 1500 watts but should not be loaded in excess of 1000 watts. This provides an allowance for future increase of load without requiring rewiring of buildings with the consequent unnecessary expense.

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Publication No. 51-313

Printed in U. S. A.

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